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*THE LAWS OF NATURE.**

WE say that nature is unchanging, and so perhaps it is, in the eye of some eternal being, but not in ours, for the things that we see from day to day, appear permanent only by comparison with the duration of our own brief life, and our own little experience.

An inhabitant of the land where nature has just passed through such an awful convulsion, with a loss of life greater for so short a time than history has ever recorded, might have said in the morning that nature never changes, because it had never changed in his own little experience; but he would not have said so at that day's close. Now the experience of the entire human race is far briefer relative to nature's duration than that of one of these islanders who knew the green mountain with its fresh lakes only as a place of quiet rest, up to the moment when the gates of hell were opened under it.

Nature, then, really changes, and would apparently do so if man were not here; for it is not man's varying thoughts about nature that make her change. But there is something quite different which does change because of man, and which apparently would not change if he were not here. This is what he calls the 'laws of nature.'

* A paper read before the Philosophical Society of Washington, May 10, 1902.

The assumption that there are such things is due to him, and such 'laws' are known only through his mind, in which alone nature is seen.

It is perhaps a hard saying to most that there are no such things as 'laws of nature'; but this is the theme on which I have to speak.

These, then, are the laws of man's own mind, or the effects of his own mind, which he projects outside of himself and imagines to be due to some permanent and unalterable cause having an independent existence. This is not only because his season for observation is but a moment in the passage of nature's eternal year, and because with his pathetic sense of his own weakness he would gladly stay himself on the word of some unchanging being. It is because this sense of dependence is strangely joined with such self-conceit that when he listens to what he himself says he calls it the voice of God. From these twin causes, arising both from his inability as a creature of time to observe nature, which is eternal, and again from his own overweening sense of his own capacity to know her, he looks for some immutable being whom he believes to have written his own ideas in what he calls 'the book of nature.'

I am not questioning the existence of such a being as the 'Author of Nature'; but asking if such a volume as is imputed to him, ever really existed. The very phrase, 'book of nature,' is a legacy from moribund mediæval notions of a lawgiver; and it, with the vitality of words which carry to us dying ideas, has lived on to our own time, when we can no longer believe it in our hearts, although it is still upon our lips.

To convince ourselves, we need only pause a moment to ask the simple question whether there is any authority who has prepared such a clearly written book of statutes in which we can really read nature's laws.

The question answers itself.

I repeat that I am not denying here the existence of such a being as the imputed author of these laws, but say that, ignorant as we are of what is being done by him, we cannot read his thoughts in our momentary vision of what is forever passing.

'For my thoughts are not your thoughts, neither are your ways my ways, saith the Lord' is a caution which, whether believers or not, it would not harm us to consider; and when we say that these 'thoughts' are written in 'the book of nature,' this cannot mean that they are legible there as in a statute book where he who runs may read. If nature is to be compared to a book at all, it is to a book in the hands of an infant to whom it conveys little meaning, for such are we; or rather it is like a 'book of celestial hieroglyphs, of which even prophets are happy that they can read here a line and there a line.'

I hope what I am trying to say may not bear the appearance of some metaphysical refinement on common sense. It is common sense that is intended, and the 'laws of nature' that seem to me a metaphysical phrase.

To decorate our own guesses at nature's meaning with the name 'laws of nature' is a presumption due to our own feeble human nature, which we can forgive for demanding something more permanent than itself, but which also leads us to have such an exalted conceit of our own opinions as to hide from ourselves that it is these very opinions which we call nature's laws.

The history of the past shows that once most philosophers, even atheists, thus regarded the 'Laws of Nature,' not as their own interpretations of her, but as something external to themselves, as entities partaking the attributes of Deity—entities

which they deified in print with capital letters—as we sometimes do still, though these 'Laws' now are shorn of 'the glories of their birth and state' which they once wore, and are not turning out to be 'substantial things.'

But are there not really things (like the fact of gravitation, for instance) external to ourselves, which would exist whether we were here or not, and which are part of the order of nature? Apparently, yes, but part of the *laws* of nature no!

The phrase even yet exercises a wide influence, though it has seemed to me that a significant change is taking place in the leaders of common opinion with regard to the meaning that the words convey.

I presume that the greater proportion of us here are interested in science. I may indeed assume that we all are; and I want to inquire what lesson for us, as students of nature, there lies in the fact that we are no longer impressed by her 'laws' as were the scientific men of a former generation.

It is convenient to measure the distance we have passed over, by the fact that one hundred and fifty years ago, one of the acutest of reasoners, David Hume, published a still celebrated argument against miracles, which within my own recollection was held to be so formidable that those who were reluctant to believe in his conclusions, were still unable to offer a good refutation. The immense number of attempted refutations and their contradictory character are perhaps the best testimony for this.

Hume defines a miracle as a violation of the 'laws of nature,' and his argument, concisely stated, is that there must 'be a uniform experience against every miraculous event, otherwise the event would not merit that appellation, and as a uniform experience amounts to a proof, there is here a direct and full proof from the nature of the fact against the existence of any miracle.'

Now while his argument is logically as conclusive as ever, it to-day convinces only those who are anxious to accept its conclusion.

What is the reason for this great change?

We may ask what the laws of nature really are, and pass from what they were thought to be by Hume to what they are beginning to be understood to be by us, without here inquiring into the intermediate steps which brought the change about.

It seems to me that the argument which was conclusive not merely to the learned, but to the common cultivated thought of Hume's time has never been expressly refuted when its premises were admitted (and the generation following him admitted them); and yet this compelling argument, as it once seemed, is gradually losing its force to most minds, not through counter argument, but by an insensible change of opinion in the attitude of the thinking part of our public as compared with his, a change about certain fundamental assumptions on which the argument rested, and from his own views of the universe to those we are beginning to take.

In the first place, the immensely greater number of things we know in almost every department of science beyond those which were known one hundred and fifty years ago, has had an effect which doubtless could have been anticipated, but yet which we may not have wholly expected. It is, that the more we know, the more we recognize our ignorance, and the more we have a sense of the mystery of the universe and the limitations of our knowledge.

I believe it may be said that, if not to Hume, at any rate to the majority of those about him, and to his later contemporaries, there was very much less mystery in the world than we see in it, and if it were then still occasionally said that there were

'things in heaven and earth not dreamt of in 'their' philosophy,' these words must have struck on the self-complacent minds of his generation as something to be tolerated as poetic license, rather than as accurate in philosophic meaning. Compared with ours, that whole century was satisfied with itself and its knowledge of the infinite, and content in its happy belief that it knew nearly everything that was really worth knowing. This 'nearly everything' which it thought it knew about the universe, it called the 'laws of nature.'

It was to this belief in the general mind, I think, that the success of Hume's argument was due.

The present generation has begun, if not to be modest or humble, to be somewhat less arrogant in the assumption of its knowledge. We are perhaps beginning to understand, not in a purely poetical sense, but in a very real one, that there may be all around us in heaven and earth, things beyond measure, of which 'philosophy' not only knows nothing, but has not dreamed.

As a consequence of this, there is growing to be an unspoken, rather than clearly formulated, admission that we know little of the order of nature, and nothing at all of the 'laws' of nature.

Now if we are at present at least, disposed to speak of an observed 'order' of nature (not carrying with it the implication of necessity denoted by 'law'), I think we have some reason to say that there is a prescience of a change in common thought about this matter, and that it is owing to this that we are coming to be where we are.

I do not know that there is a less wide belief in the gospel miracles in our day, but if it were so, the decline in the weight given Hume's argument is not due solely to that, for it may surely be said that it was not merely an argument against gospel miracles, but against all the prodigies to be found in history, sacred and profane, where he doubtless had in mind traditions of stones falling out of heaven, cures wrought by psychological agency, and the like, all 'superstitions' to the men of his day. These if they no longer believed in a deity, were none the less shocked by the culpable existence of such vulgar beliefs in conflict with the deified 'laws of nature,' while such 'superstitions' have in our day become subjects of modest inquiry.

Let me quote from a later writer, whose point of view is singularly different from that of Hume and his contemporaries, and who in answer to the question, 'What is a miracle?' begins by reminding us that the reply will depend very much upon the intelligence of the being who answers it, or whom the miracle is wrought for.

"To my *horse,* do I not work a miracle every time I open for him an impassable turnpike?"

"But is not a real miracle simply a violation of the 'laws of nature'? ask several. What are the laws of nature? Is it not the deepest law of nature that she be constant?" cries the illuminated class; "is not the machine of the universe fixed to move by unalterable rules?"

"I believe that nature, that the universe, which no one whom it so pleases can be prevented from calling a machine, does move by the most unalterable rules. And now I make the old inquiry as to what those same unalterable rules, forming the complete statute-book of nature, may possibly be?

"'They stand written in our works of science,' say you; 'in the accumulated records of man's experience.' Was man with his experience present at the creation, then, to see how it all went on? Have any deepest scientific individuals yet dived down to the foundations of the universe, and gauged everything there? Alas, these scientific individuals have been nowhere

but where we also are; have seen some handbreadths deeper than we see into the deep that is infinite, without bottom as without shore.''

''Philosophy complains that custom has hoodwinked us from the first; that we do everything by custom, even believe by it; that our very axioms, boast as we may, are oftenest simply such beliefs as we have never heard questioned. Innumerable are the illusions of custom, but of all these perhaps the cleverest is her knack of persuading us that the miraculous, by simple repetition, ceases to be miraculous!''

A lesson for us, as people who are most of us interested in science, showing how little its most fixed conclusions may be worth, may perhaps be conveyed in an example. A century and a half ago, when the new science of chemistry won its first triumphs, the fundamental discovery which was to illuminate the whole science, the settled acquisition which it seemed to have brought to us, the thing which was going to last, was 'phlogiston.'

This had everything to recommend it, in universal acceptance, and in what seemed to the foremost men of the time, its absolute certainty.

''If any opinion,'' says Priestley, ''in all the modern doctrine concerning air be well founded, it is certainly this, that nitrous air is highly charged with phlogiston. If I have completely ascertained anything at all relating to air, it is this.''

I am trying here to say that laws of nature are little else than man's hypotheses about nature.

Phlogiston was then to the science of a former age, in this sense a law of nature, at least as great a generalization as the kinetic theory of gases is to us; as widely accepted, as firmly believed and as certainly known—but what has become of it now?

Can we tell, then, in advance by any criterion what a 'law of nature' is?

With a curious begging of the question some answer, 'Yes, for laws of nature have this distinction, that they have never been disproved.' As if one were to say, Yes, because when they *are* disproved we deny that they are laws of nature!

Those of us who are capable of being instructed or warned by the history of human thought may, then, ask what kind of a guarantee are we to have for any other 'fact' of our new knowledge? May they not—all these 'facts'—be gone like the baseless fabric of this vision, before another hundred years are passed?

The physical sciences seem to have had less change in their theories than the mighty displacements in other branches of natural knowledge, but it is a truism to say that all are changed, and it should be a truism to add that the 'laws of nature' are not to us what they were a hundred years ago.

I repeat that of the 'order' of nature we may possibly know a little; but what are these 'laws' of nature? What celestial act of congress fixed them? In what statute book do we read them? What guarantees them? Our mistake is in believing that there is any such thing, apart from our own fallible judgment, for the thing which the 'laws of nature' most absolutely forbid one generation to believe, if it only actually happens, is accepted as a part of them by the succeeding.

Suppose that a century ago, in the year 1802, certain French Academicians, believing like every one else then in the 'laws of nature,' were invited, in the light of the best scientific knowledge of the day, to name the most grotesque and outrageous violation of them which the human mind could conceive. I may suppose them to reply, 'if a cartload of black stones were to tumble out of the blue sky above us, before our eyes, in this very France, we

should call *that* a violation of the laws of nature, indeed!' Yet the next year, not one, but many, cartloads of black stones did tumble out of the blue sky, not in some far off land, but in France itself.

It is of interest to ask what became of the 'laws of nature' after such a terrible blow. The 'laws of nature' were adjusted, and after being enlarged by a little patching, so as to take in the new fact, were found to be just as good as ever! So it is always; when the miracle *has* happened, then and only then it becomes most clear that it was no miracle at all, and that no 'law of nature' has been broken.

Applying the parable to ourselves then, how shall we deal with new 'facts' which are on trial, things perhaps not wholly demonstrated, yet partly plausible? During the very last generation hypnotism was such a violation of natural law. Now it is a part of it. What shall we say, again, about telepathy, which seemed so absurd to most of us a dozen years ago? I do not say there is such a thing now, but I would like to take the occasion to express my feeling that Sir William Crookes, as president of the British Association, took the right, as he took the courageous, course in speaking of it in the terms he did. I might cite other things, the objects of ridicule only a few years ago, of debate now, but which have not all found supporters who possess the courage of their convictions.

The lesson for us in dealing with them is not that we should refuse to believe, on the one hand, and sneer at everything which is on its trial; for this, though a very general and safe procedure, is not the one to be recommended to those of us who have some higher ideal than acquiescence with the current belief.

The lesson for us is that we must not consider that anything is absolutely settled or true.

This is not to say that we are to be blown about by every wind of scientific doctrine. It is to be understood as a practical rule of life, that we must act with the majority where our faith does not compel us to do otherwise; but it seems to me that we must always keep ready for use somewhere; in the background of our mind possibly, but somewhere, the perhaps trite notion that we know nothing absolutely or in its essence; and remember that though trite it is always true, and to be kept as a guide at every turning of the scientific road, when we cannot tell what is coming next.

How many doctrines of our own day will stand the light of the next century? What will they be saying of our doctrine of evolution *then?* I do not know; but let me repeat what I have said elsewhere, that the truths of the scientific church are not dogmas, but something put forward as provisional only, and which her most faithful children are welcome to disprove if they can. I believe that science as a whole is advancing with hitherto unknown rapidity, but that the evidence of this advance is not in reasoning, but in the observation that our doctrine is proving itself, by the fact that through its aid nature obeys us more and more, as I certainly believe it does.

Never let us forget, however, that man, being the servant and interpreter of nature, as Bacon says, can do and understand so much, and so much only, as he has *observed* of the course of nature, and that beyond this he neither knows anything nor can do anything. No walk along 'the high priori road' will take him where he wants to go, and no 'law of nature' will certainly help him.

But these 'laws,' having authority only as far as they are settled by evidence, and by observation alone, it may be a just inquiry as to what constitutes observation, and above all, who judges the evidence. If the kinetic theory of gases, for in-

stance, is a matter of inference rather than of observation, are we sure that we have a better guarantee for it than a previous century had for phlogiston? Our good opinion of ourselves, as compared with our scientific fathers, makes us think we have. I think myself that we have; and yet, remember, it is the same human nature which judged that evidence then, that judges this evidence now, and remember that however rapidly science changes human nature remains very much the same, and always has a good conceit of itself.

While we are venturing to utter truisms, I repeat, let us take once more this one, home to ourselves, that there is a great deal of this 'human nature' even in the best type of the scientific man, and that we of this twentieth century share it with our predecessors, on whom we look pityingly, as our successors will look on us.

Let us repeat, and repeat once more, that though nature be external to ourselves, the so-called 'laws of nature' are from within —laws of our own minds—and a simple product of our human nature. Let us agree that the scientific imagination can suggest questions to put to nature, but not her answers. Let us read Bacon again, and agree with him that we understand only what we have observed. Finally let us add that we never understand even that, in the fullness of its meaning, for remember that of all the so-called laws of nature the most constantly observed and most intimately and personally known to us, are those of life and death—and how much do we know about the meaning of *them?*

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KINETIC EVOLUTION IN MAN.

IN a recent number of SCIENCE Mr. W J McGee has summarized his reasons for holding that anthropological evolution is a process of integration standing in direct contrast to the divergence of biological evolution:

"The great fact attested by all observation on human development, and susceptible of verification in every province and people, is that mankind is not differentiating in either physical or psychical aspects, but are converging, integrating, blending, unifying, both as organisms and as superorganic groups.

"Everywhere the developmental lines converge forward and diverge backward, just as the lines of biotic development diverge forward and converge backward. How this discrepancy is to be removed is a question whose importance increases with every advance in the science of anthropology."*

That human evolution is synthetic appears undeniable, but the discrepancy pointed out by Mr. McGee has been removed in advance by the recognition of the same leading principle in biological evolution. Man is better known than any other animal, and evolutionary theories which do not accommodate this best certified series of biological facts might well have been distrusted. The kinetic factor of synthesis has been neglected because biologists as well as anthropologists have failed to perceive that evolutionary progress is a cause instead of a result of the differentiation of species or varieties, but since evolution must be studied in species an adequate comprehension of the evolutionary phenomena of any specific group should make plain their relation to more general principles.

Isolation and segregation favor constancy in the characters by which systematists are accustomed to distinguish species, but it is as erroneous with other animals as with man to infer from this that isolation conduces to evolutionary

* 'Current Questions in Anthropology,' SCIENCE, N. S., Vol. 14, No. 365, pp. 996 and 997.

progress. The truth lies rather with the contrary proposition, since the unknown causes of variation also predispose to the perpetuation, communication and accumulation of organic, physiologic and other tendencies of change. Some variations or mutations are of little evolutionary significance and must be segregated in order to be preserved, but others are notably prepotent and are accepted by a large proportion of the individuals of successive generations. Reproductive accessibility to prepotent variations is the measure of evolutionary progress. Species confined to small areas are often distinct from each other by characters of no diagnostic significance among related forms of wide distribution. The latter appear plastic and flexible because they have access to many avenues of biological motion, while the former maintain a relatively narrow and stable uniformity because the few genetic variations are soon distributed through the small number of individuals.

Evolution may be termed a kinetic* process because change is not only a potential but an essential of organic existence. Static theories have sought to explain organic changes as the results of external influences; dynamic theories imply the organic predetermination of such changes; only under a kinetic theory may we admit that the changes of biological evolution have not been caused by external conditions nor by internal mechanisms, but are the manifestations of a form of motion the nature and efficient causes of which are even farther beyond the present range of our comprehension than those of the motions which underlie the phenomena of physics and chemistry.

However striking their results in particular instances, natural and other forms of selection represent the incidents rather than the causes of evolution, and instead of being called forth and carried forward only by external forces, the gradual accentuation of characters of no direct importance or utility commonly accompanies increasing organic efficiency. Thus it has been found that varietal divergences from the specific mean of the human skull are correlated with increased intellectual power, as represented by greater cerebral bulk.

"In a brachycephalic race the rounder the skull the greater the capacity, in a dolichocephalic race the narrower the skull the greater the capacity—the greater capacity following the emphasis of the racial character."*

Equally indifferent functionally and selectively are most of the characters of skin, hair, bones and other physical features used by anthropologists in classifying mankind, and in speculating upon the origins of the various ethnic groups. Closely analogous differences are found everywhere among the species and varieties of mammals, and they require no special explanation unless it be to place them among the many indications that the varieties of primitive man had fewer facilities of transportation and more definite geographical localization than their modern representatives. Had such segregation become complete all the requirements for the differentiation of species would have been met, and modern zoologists could make no serious or consistent objection to the treatment of the Tasmanians, Australians, Andamanese, Papuans, Ainus† and similarly isolated groups as species, no matter how insignificant a fraction of

* 'A Kinetic Theory of Evolution,' SCIENCE, N. S., Vol. 13, June 21, 1901, p. 969.

* Alice Lee in SCIENCE, N. S., Vol. 12, No. 312, p. 948.

† I am indebted to Dr. Leonhard Stejneger for the suggestion of racial affinity between the Papuans and Ainus. Dr. Stejneger holds also that the domestic and social economy of the Ainus indicates tropical origin.

the genus *Homo* they may include. On the other hand it seems preferable to admit that these islanders are but outliers of the larger curl-haired specific complex which covered the Old World before the arrival of the coarse-haired, smooth-skinned American species of mankind. On the continents strictly isolated groups have seldom existed for long periods, although the separation of remote peoples has been sufficient to permit the accumulation of diverse habits and characteristics which in less active, intelligent and resourceful animals would have resulted in disintegration into many segregated species.

A kinetic theory of evolution permits us to recognize the fact that with man, as in other lines of descent, there have been both differentiation and integration, and these not at separate times, but simultaneously and universally.* Moreover, we gain a standpoint from which many formal propositions like monogenesis and polygenesis appear unnecessary for the exposition of evolutionary facts. From the standpoint of biological evolution it is about equally improbable that any given species has descended from one or two parents as that it has been compounded from distinct lines of descent. Mr. Keane, who is cited by Mr. McGee as a polygenist, is fond of discussing what he calls 'precursors' but he apparently holds still to the traditional supposition that different races originated in Central Asia and subsequently spread themselves to the various quarters of the globe, a proposition obviously contrary to all pertinent analogies of general biology. We are not told why one neighborhood should have given rise to so much diversity, nor why the newly formed races did not fuse at once into one homogeneous complex and thus save the ethnologists much speculation.

Few discussions of the evolution of man are without one or more of the following assumptions:

1. That man originated at some particular locality.

2. That he became differentiated into three or more distinct races or varieties.

3. The commingling of these formed the numerous peoples of the earth whose origins and pedigrees are to be inferred by resolving their characteristics into those of the component racial types, much as the artist analyzes his colors or the chemist his compounds.

Monogenists and polygenists are about equally partial to these unproved and improbable opinions, and as their differences are matters of formal terms and definitions the opportunities for scholastic controversy are excellent. At some sufficiently remote time there was a species of limited distribution which included the direct progenitor of man, but was this interesting creature man or ape? And did it differentiate into races of men or merely into varieties of apes or 'precursors' which became human independently and then hybridized to form the complex now called man? These questions can be debated indefinitely by the well-known expedient of varying the definitions which shall determine when the animals became men in the modern sense and were no longer 'old time people,' as the natives of Liberia call the chimpanzees.

But since no other animal or plant has the wide distribution of man, we may well suppose that this was attained after he had far surpassed all related species in intelligence and resourcefulness, and further

* That divergence as well as convergence has occurred even in the historic period is well shown by such examples as the colonists of Virginia and Massachusetts who though they had formed part of the same community in England developed on independent lines in America until they were reincorporated into another social and political organization. The South African Boers might also be compared with the Dutch colonists of New York.

that the same qualities and tendencies which gave him this extensive range have prevented complete isolation, except in the presence of physical barriers. Polygenesis ascribes these unique powers to several apes in spite of the fact that with the exception of man, all existing species of the order Primates are animals of very limited distribution.

The doctrine of polygenesis marks a natural reaction from that of a too narrow monogenesis, but in its extreme extension attains an equal absurdity. Moreover, the term itself is unfortunate in implying many distinct centers or lines of descent which would but multiply the difficulties. The logical and biologically defensible antithesis of monogenesis is not polygenesis but eurygenesis, or the predication of a wide and largely decentralized distribution of primitive man or his precursors, if the term be preferred. Strictly speaking, man might be monogenetic and still originate all over the world by the gradual amelioration of a cosmopolitan species; and polygenesis by requiring two or more separate derivations or ameliorations, is on the biological plane an assumption inconsistent with that of an evolution by convergence and integration which would be retarded rather that advanced by the implied isolation.

Exponents of both monogenesis and polygenesis apparently neglect also the obvious fact that man's origin and primary distribution are zoological rather than ethnological questions, since an indefinitely great period of time must have elapsed between the organic perfection of man and the development of the races, languages, customs and arts studied by anthropologists. But even on zoological and geological grounds the question of origin is still in the balance, and as competent an anthropologist as Sir William Flower frankly admits that 'it is quite as likely that the people of Asia may have been derived from America as the reverse.'*

Not even the fact that all of man's quadrumanous relatives were confined to the Old World is conclusive. Indeed, it is strange that under static theories of evolution it was not argued that man must have originated in America, on the ground that he would not have attained his human characteristics while exposed to intermixture with his more backward simian relatives. And in further support of such a view it might have been observed that the curled hair which characterizes the peoples deemed most primitive in the Old World is apparently a specialization, the higher apes having straight hair. Likewise the small cerebral bulk of even the most advanced of the aborigines of America does not indicate descent from larger brained Old World stock.

In accordance with the evidence of tradition, history and general biology we may ascribe the convergence and integration of customs, languages and races to the intercommunication which is at once a cause and a result of human progress toward civilization. No one race or nation has had a monopoly of improvement and discovery and those which continue to progress generally obtain more from others than they originate themselves. Specialization and isolation which resist change are as clearly misfortunes to nations as to plants and animals. Within historic times the physical and intellectual powers of the race are not known to have increased, but the synthesis of skill and knowledge has continued with accelerated rapidity. Modern nations pride themselves on their adaptability, and no longer emulate the changelessness of the Medes and Persians and the Chinese.

That the nations of the earth are of one blood does not mean that they were ever of

* *Journ. Anthrop. Inst. Gt. Britain,* 14: 391. London, 1885.

one language or one system of customs and arts, in the origination of which the doctrine of polygenesis has a wide application, since history and daily experience show that new linguistic, industrial and artistic elements originate in definite places and often with single individuals. The use of tools and weapons gave man the advantage over his fellow-creatures, and progress has been mirrored in the diversification and improvement of these servants ever since the time when all men used the unspecialized celt which the reminiscent native of Liberia still holds in his hand in leisure moments to give him that most enjoyable sensation of weight and importance. Modifications and inventions are constantly being made; use is necessarily local and hence divergent at first, but with modern facilities of communication may extend in a few years through regions which formerly would not have been penetrated in as many generations.

Civilization itself is at once a test and a testimony of the attraction exerted by new characters, powers and specializations, and of the momentum with which the motion due to such attractions may increase. Primitive and conservative are ethnological synonyms, and with races, as with individuals, it is ever the strongest and the most intelligent which are susceptible to the new idea or invention. The constant succession of modes and fashions is perhaps the most obvious example of the inherent human tendency to the new, and motion on this line is also conspicuously more rapid in our complex and utilitarian civilization than among primitive peoples. Human progress has not advanced by a uniform rate of motion; the facts of ethnology and history indicate the probability that it took more centuries to introduce the use of fire than it has required years to popularize electricity.

Somewhere intermediate between the zoological monogenesis of man's body and the ethnologic polygenesis of nations, languages and arts, there was what may be termed a biologic coordination of man and his supporting environment which placed him definitely upon the line of social and industrial progress. As long as man was content to rely upon natural products his existence was precarious and left no traces in organic nature, but in passing from the feral to the domestic state he interfered in the evolution of other species and thus gave biological clues for the location of this focus of anthropological interest. The cultivated plants were in use long before the integrations which formed present peoples, languages and arts, and thus afford far more weighty testimony on racial origins and affinities.

The Egyptian and Chaldæan civilizations mark the eastern horizon of human history, but from the evolutionary standpoint they appear separated from us by but a narrow foreground. Our belief in their primal antiquity is but a reflection of traditions chronologically ancient, though biologically recent, and affording no valid opposition to the evidence that the oldest domestic plants were not natives of the Old World, but of the New, where the scarcity of nourishing fruits encouraged the use and simple cultivation of starch-producing roots, which before the domestication of cereals became the basis of a permanent food-supply and of social, industrial and cultural progress, impossible among wandering hunters and shepherds.

It has seemed reasonable to seek the origin of civilization among the most capable peoples, but, on the other hand, it should be remembered that great natural abilities have not produced civilizations except under favorable conditions. In Roman times the Teutonic peoples had not advanced much beyond the economic status of sav-

ages, and yet with brief opportunity they were able to adopt and even to improve upon the ancient cultures of the Mediterranean countries. Civilization is not an inherent but merely a potential character, more easily lost than gained, and in its earlier stages readily influenced by facts and conditions as truly biological as those which have conduced to the upbuilding of the even more specialized organization of the social ants and termites.

On this ground we may also disregard the opinion general among ethnologists and historians that the pastoral stage with which the civilization of the Mediterranean region was supposed to have begun was merged gradually and spontaneously into the agricultural. Primitive pastoral tribes are everywhere more or less nomadic, and pastoral prosperity does not conduce to a more settled existence, but makes necessary a wider range of feeding grounds, so that we should need to imagine the semi-savage shepherd planting and fencing plots of millet, barley or beans with the intention of experimenting upon new vegetable foods. But such an idea is so absurdly inconsistent with the instinctive conservatism of man's food habits that we can but believe that the pastoral natives of the Mediterranean region built civilizations only when brought into synthesis with other peoples who had made independent progress on agricultural lines.

Predatory, nomadic and pastoral peoples may develop excellent physical and mental powers, but the primary condition for the genesis of civilization is the settled social organization of an agricultural community. That agricultural habits of life conduce to civilization even among relatively inferior tribes is well shown in the numerous centers of ancient primitive culture developed in the tropics of the American continent. Ethnologists have decided that all this diversity of incipient civilizations was truly indigenous and not imported, as formerly suspected on the ground of many racial and cultural resemblances with the peoples of eastern Asia. This opinion is further supported by the biological fact that of the many plants cultivated in ancient America only the banana appears to be exotic, and this probably arrived not many centuries before the coming of Europeans.

The American origin of agricultural man in no way conflicts with an Old World origin for zoological and geological man, though these questions are often confused by ethnological writers. Such cultural tendencies as may have existed in the Mediterranean region before the arrival of agricultural influences from America appear to have been confined to the domestication of animals as the basis of a diet largely carnivorous. The aborigines of the island of Palma in the Canary group had four domestic animals and no domestic plants. The predication of independent agricultural beginnings in the Old World is rendered unnecessary by two facts long well known though strangely neglected; first, that the tropics of the Old World from Hawaii and Easter Island to Madagascar and Sierra Leone were overrun by a single primitive, agricultural, seafaring race; and, second, that this race was in possession of numerous cultivated plants of American origin. To infer from these facts that the Polynesians, Malays or Chinese came from America would be to ignore the probability that the trans-Pacific migration of this primitive culture race took place long anterior to the formation of existing peoples and languages. The identity of the tropical cultivated plants, several of which are propagated only by cuttings, renders gratuitous all objections on the score of distances and difficulties of communication, and the racial and cultural similarities of the peoples

of the two shores of the Pacific render their community of origin antecedently probable. Ethnologists have demonstrated the indigenous character of American man, but the coarse-haired yellow and brown races of Asia are evidently intruders who have replaced or amalgamated with older curl-haired peoples. While it is not impossible that some elements of the Mongoloid series may have entered Asia from the northeast, the tropical plants could scarcely have been taken over by way of Alaska, and megalithic ruins and other traces of primitive cultures similar to those of ancient America mark a route from Easter Island to Fiji, Sumatra, Madagascar and southern Arabia, whither archeologists now trace the straight-haired men who initiated the agricultural civilizations of the valleys of the Nile and Euphrates.

With the assistance of a kinetic theory of evolution and of pertinent facts and analogies it is thus possible to sketch anthropological evolution without the predication of conditions essentially different from those which exist at the present day. Man is a relatively ancient animal which long since attained a cosmopolitan distribution. Divergent tendencies of variation met, however, with ever-strengthening opposition through the growth of mental powers and social habits, and the segregation of groups comparable to zoological species took place only through geographical isolation. The specific separation of the peoples of the two continents also came to an end with the development in America of the arts of agriculture, navigation and government, which resulted in the conquest and colonization of the islands and shores of the Pacific and Indian Oceans, and the subsequent integration of the superior mixed races and civilizations of these and the adjacent regions.

O. F. COOK.

WASHINGTON, D. C.

THE NEW LABORATORY AND GREENHOUSE FOR PLANT PHYSIOLOGY AT SMITH COLLEGE.

THE remarkable renascence which botany is experiencing in America, both in investigation and in education, is intimately associated with the development of plant physiology. The reason is plain. The present movement is essentially an exploitation of the new field opened up by our new view of the plant as not primarily a living structure, but a living being. Hence the study of all vital processes becomes of first importance. The new physiological equipment of Smith College, here to be described, is an adaptation to the ever-increasing importance of plant physiology.

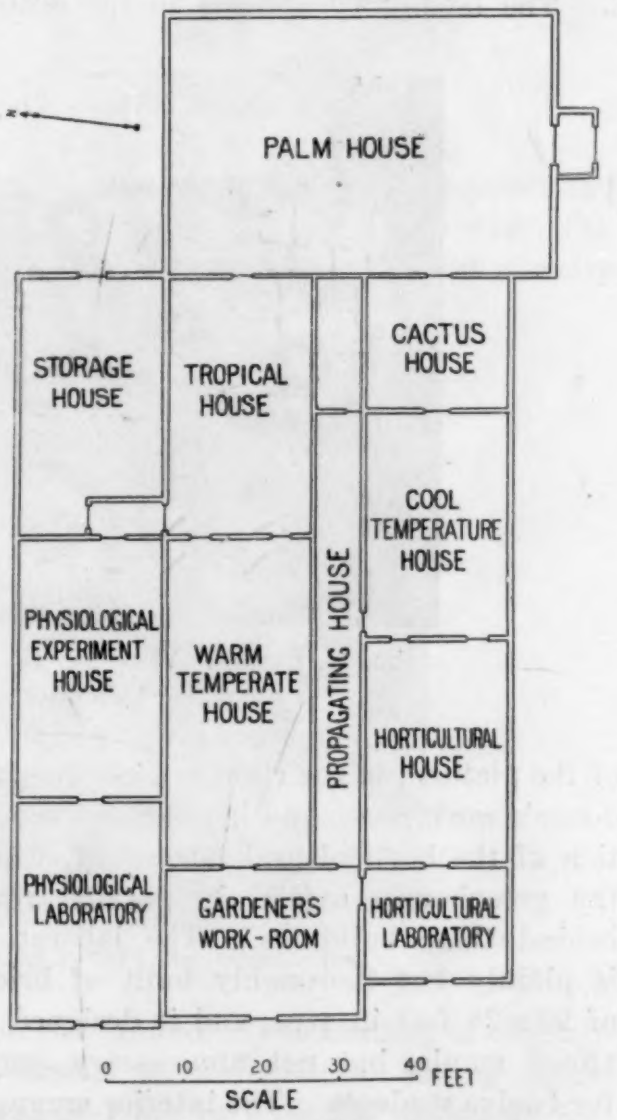


FIG. 1. Ground-Plan of the Lyman Plant House at Smith College.

Smith College has possessed for four years, as an adjunct of the Department of Botany, a thoroughly built, properly stocked and fully manned range of greenhouses, known as the Lyman Plant House, of which the ground-plan is illustrated herewith (Fig. 1). The new laboratory and greenhouse, now completed, have been attached to the range as shown in this plan. The storage house is at present used as a cool house for plants not in growth, but it is so built that, if the expansion of the college work requires, it can be added to the experiment house by the simple removal of a partition.

The appearance of the laboratory in relation to the greenhouses is shown in Fig. 2. The laboratory appears in the center of the picture; to the right is seen the gardener's work room, and beyond that a portion of the horticultural laboratory, while the greenhouses extend in parallel rows behind these buildings. The laboratory is plainly but thoroughly built of brick, of 20 x 28 feet in area, and is designed to afford ample, but not unnecessary, room for twelve students. The interior arrangements are well shown by Figs. 3 and 4. There are three sorts of tables. The study tables, at which each student has a place with a drawer for personal effects, are of the plain laboratory sort. The apparatus tables, for the assembling of the appliances for experiments, are made three feet in height for convenience of working standing, and beneath them the space is utilized for cupboards in which bell-jars and the larger glassware are stored. The gas and tool table, in front of a window (on the left of Fig. 3), also three feet in height, is fully equipped with the appliances suggested by its name. There are three sets of cases. One is for balances, shown on the left of Fig. 4, with three compartments, and glass doors (shown open in the picture). This is affixed to the brick wall disconnected from the floor, and its top is utilized for the storage of large articles. The second is for chemicals, shown on the right in Fig. 4 (also with glass doors open), with cupboards beneath. The third consists of three cases for the storage of the more elaborate appliances, of which the equipment is excellent; they are partially shown with closed doors on the left of Fig. 3. Beneath them are many drawers, for

Fig. 2. General View of the Lyman Plant House, with the New Laboratory in the foreground.

the storage of the numerous articles necessary in a course in which every student works through a comprehensive series of physiological experiments. And the other furniture proper to such a laboratory, including a blackboard ruled in squares for the plotting of statistical data, is of course present.

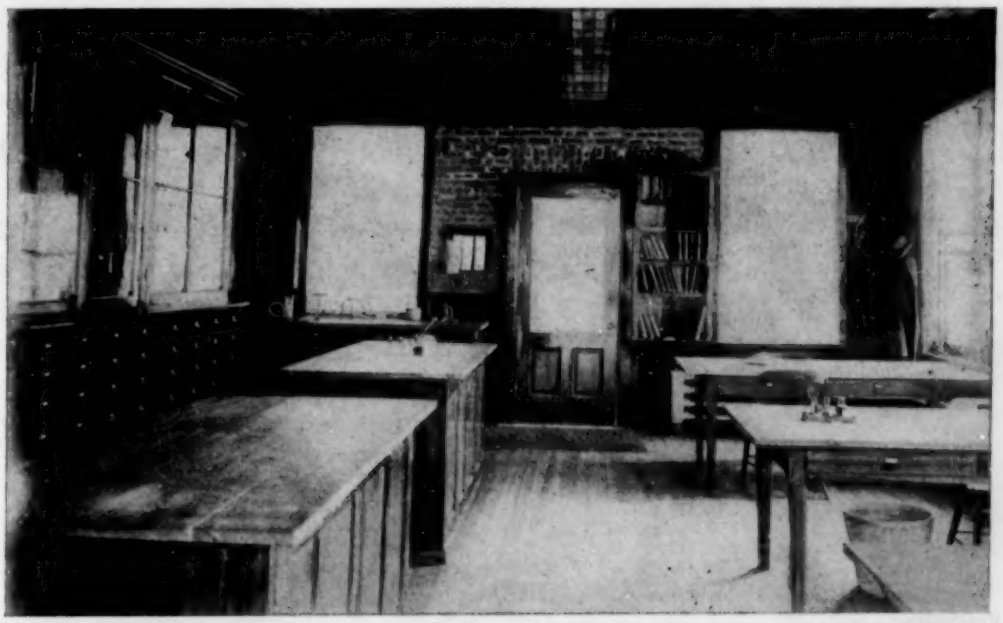


FIG. 3. View in the Laboratory, from the door of the Greenhouse.

More important, however, is the greenhouse, which is illustrated by Figs. 5 and 6. It is 20 x 32 feet in area, very thoroughly built, with ample and readily controlled heating and ventilation systems. The heating pipes are placed against the walls, where they are not in the way. The floor is of cement, of course laid directly upon the ground. The shading is effected by screens of white cloth, resting upon wires; they are very readily drawn up for use or down completely out of the way.

FIG. 4. View in the Laboratory, looking toward the Greenhouse.

Against the wall of the laboratory (Fig. 6) is a long porcelain-lined sink, with five taps, to which are attachable the tubes leading to a still, an exhaust (with manometer), and a blast, while the necessary funnels, graduates, etc., are arranged above and the pneumatic troughs, basins and the like, beneath it.

Of especial importance in such a greenhouse are, however, two things, the tables and the physiological dark room. There are sixteen tables. Each top is of a single thick, smooth slate, four feet by two, resting at the four corners upon adjusting screws by which they may be set level. The stand, especially designed for the purpose, is of cast iron, of such a pattern as to give the greatest possible rigidity, and of such a height as to bring the top of the table three feet from the floor, a height which experience has shown to be the best for the average student when working standing. They are proving perfectly satisfactory in use. The central table of the greenhouse is covered by a white wooden shelter, lightly built, under which are kept the autographic meteorological instruments, thermograph, hygrograph, etc., indispensable in such a laboratory. Finally we consider the physiological dark room, perhaps the most essential part of the furnishing of a laboratory of plant physiology. It is built of one thickness of brick against the wall of the laboratory (on the right in Fig. 6), but otherwise has an air space all around it whereby it is kept approximately at the average temperature of the greenhouse. It is nearly six by six feet in area, and from six to eight feet high inside. The ventilation is provided for by an arrangement of double-walled black boxes over openings left in the brickwork near the floor, and by a triple roof with communicating air spaces. The details cannot readily be briefly described, but the result is a perfect system of ventilation without the admission of the slightest ray of light. The door has an inner porchway with a second door, both made light-tight by rubber strips, so that by closing one door before opening the other, it is possible to enter or leave the room without the admission of any light. It is provided with shelves, and is entirely painted a dull black inside.

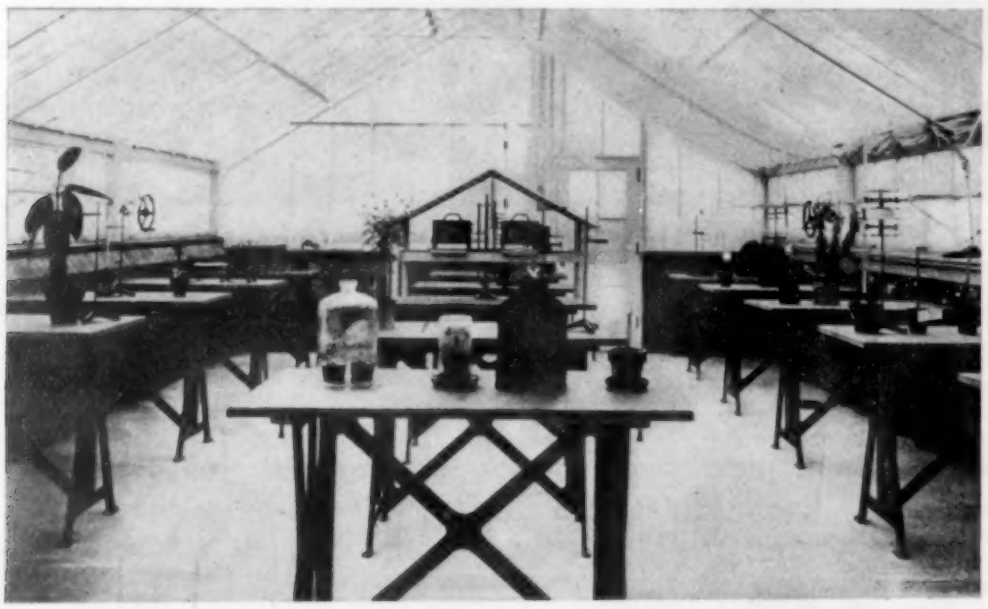


Fig. 5. View in the Greenhouse, from the door of the Laboratory.

A point of much interest about this en-

tire equipment is that it is not intended for investigation (other than pedagogical), but for the instruction of undergraduate students. This is in accord with the policy of the trustees of Smith College, which aims not to develop university work, but to concentrate all effort upon the undergraduate course. This course in plant physiology is taken each year by twelve students, seniors who must previously have had at least two years of botanical study; they work through the course described in the present writer's book, 'A Laboratory Course in Plant Physiology.'

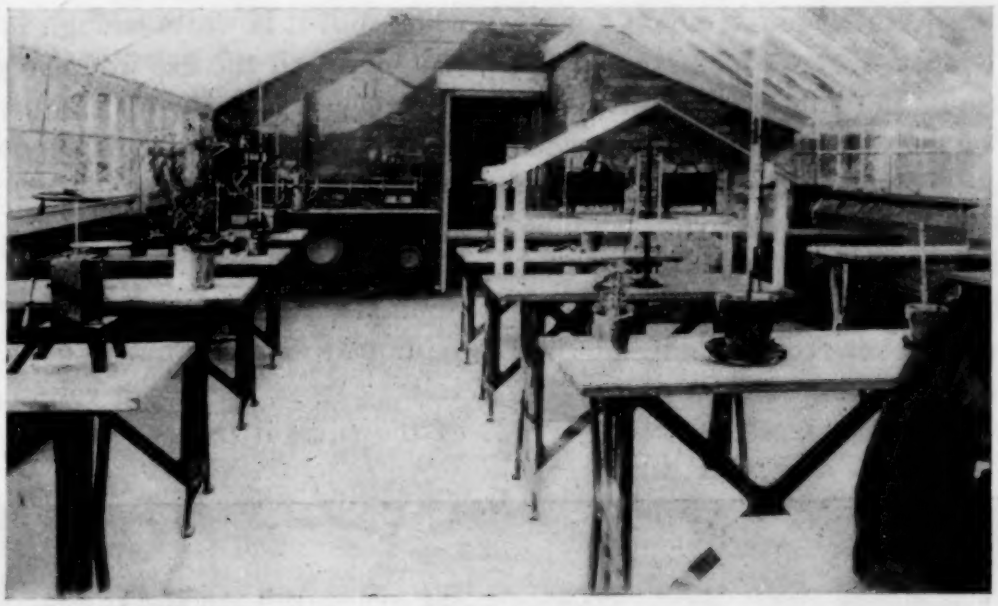


FIG. 6. View in the Greenhouse, looking toward the Laboratory.

The Lyman Plant House was a gift to Smith College from the late Mr. E. H. R. Lyman, of Northampton and Brooklyn, N. Y., in memory of his mother. The new addition to this most appropriate and serviceable memorial is the gift of Mr. Lyman's son, Mr. Frank Lyman, and his daughter, Mrs. Alfred T. White, and her husband. The details of construction have received the close personal attention and the very generous interest of Mr. W. A. Burnham, of the firm of Lord and Burnham, of New York, by whom the additions, as well as the original range, have been constructed. As now finished, the enlarged plant house provides the college with the most essential part of a material botanical equipment of unsurpassed completeness and excellence.

W. F. GANONG.

AN ELECTRIC LAMP FOR MICROSCOPE ILLUMINATION.

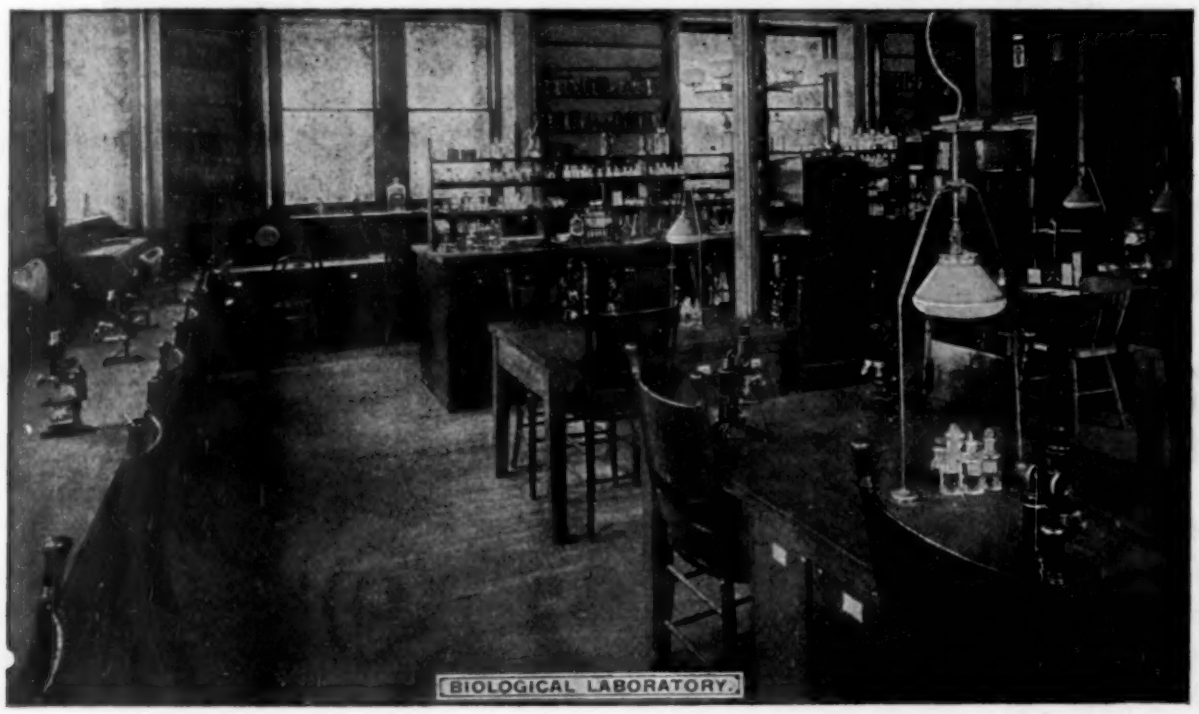
THE chief desiderata for a microscope lamp are brilliancy and whiteness of light and an evenly illuminated surface of considerable extent from which to take the light. In planning eight years ago for the illumination of our biological laboratory at the Woman's College of Baltimore, we took into consideration Welsbach lamps and incandescent electric lamps, deciding on the latter. The ordinary incandescent bulb is too small to serve unmodified as the source of light for microscope illumination, and its light is too yellow. These difficulties, however, we have overcome with a fair degree of success by the adoption of two simple devices. Nearly white light is obtained by using forty-volt lamps on our fifty-volt current. This gives much more perfect incandescence than is obtained

with a lamp adapted for the voltage used, and, though the lamps burn out more quickly, still they last for a considerable time. Of the eighteen bulbs in use in our laboratory we have to renew about four a year, say twenty-five per cent. annually. We make use of the lamps only during the latter part of the afternoon in winter when the days are short. Little use is made of them at night. A forty-five-volt lamp on a fifty-volt current wears much longer than a forty-volt lamp, and gives a light much less yellow than that from a lamp adapted for the voltage used. For ordinary use such an arrangement is satisfactory.

minated, and the two ground-glass surfaces through which the light passes gives it a very soft effect.

The light thus obtained is not perfectly white, but it is white enough to prove satisfactory in all the use we have given it, and it is very brilliant. We frequently use it in preference to daylight in the demonstration of minute structures, for example in the study of mitosis.

The essential features of this plan of illumination are the diffusion of the light as explained and having bulbs adapted for a voltage from five to ten volts less than that of the current in use.



An evenly illuminated surface of considerable extent is obtained in the following way: First a ground glass bulb is used which softens the light; then this is mounted in an ordinary reading globe with mirror back and ground glass front (cf. figure). The mirror-backed globes are much preferable to those with painted backs. The soft light from the ground-glass bulb is so reflected from the mirror at the back of the globe that the whole ground-glass front of the globe is nearly uniformly illu-

These lamps may be mounted in many different ways. We use horizontal stationary lamps between each two desks around the outside of our laboratory; and in the middle of each of the central tables which are used by four students apiece, we have a stationary bracket in which the lamp may be raised or lowered, the lamp fastening by a thumb screw. Professor Drew, of the University of Maine, tells me that he has adopted the same style of lamp in his laboratory, but that he has them

mounted on flexible arms which allow the lamp to be placed in any desired position. This seems to me preferable to either mounting we are using.

MAYNARD M. METCALF.
THE WOMAN'S COLLEGE OF BALTIMORE.

*WORK OF THE AGRICULTURAL EXPERIMENT STATIONS.**

THE agricultural experiment stations in the different States and Territories, as well as the colleges with which they are connected, have been unusually prosperous during the past year. Two things have especially contributed to the greater expansion and increasing efficiency of their investigations. These are their closer affiliation with this Department and the material enlargement of the resources of the agricultural colleges, by means of which the stations have directly or indirectly been benefited.

COOPERATION BETWEEN THE STATIONS AND THE DEPARTMENT.

Much progress has been made in determining the lines in which the stations can most effectively cooperate with the Department, and the methods of arranging and conducting cooperative operations. Since both the stations and the Department have had enlarged resources, it has been possible not only to increase the number of cooperative enterprises, but also to conduct them on a larger scale. In some cases it has been found desirable to form groups of stations to investigate some problem affecting a large region. Thus, for example, a group of stations, in cooperation with the Bureau of Plant Industry, are engaged in investigations on the breeding of varieties of cereals adapted to the Northwest. In other cases a single station is sufficiently aided by the Department to enable it to undertake the thorough treatment of problems in a special line. Thus the Pennsylvania Station, in cooperation with the Bureau of Animal Industry, is preparing to make elaborate researches in animal nutrition, and for this purpose has devised and built a respiration calorimeter for experiments with large animals, which in size and complexity surpasses any apparatus hitherto used for such experiments. In other cases, two or more branches of the Department combine to work in conjunction with a station on some complex problem. Plans are now being made, for example, for an extensive experiment on the problems of range conservation and improvement, in which the Arizona Station will unite with the Bureaus of Forestry and Plant Industry and the Office of Experiment Stations (irrigation investigations). It is evident that a very great variety of effective combinations can be made with the general result of a union of forces thoroughly acquainted with local conditions with those having broad views and relations. Such a strong combination of forces for attacking the problems of agriculture exists nowhere else. It is believed, therefore, that largely increased benefits will soon accrue to our agriculture from this union of the stations with the Department. At the same time the stations were never so strong locally, and are better equipped than ever before to work by themselves on problems of immediate importance to their own constituencies.

The records of this Office show that the Department is at present cooperating with the stations in 43 States and Territories. Among the subjects on which cooperative investigations are being conducted are the following: Tests of varieties of grasses and forage plants in many localities; special experiments with grasses and forage plants for the arid region and the improvement of range lands; breeding ex-

* Part of the Annual Report of the Director of the Office of Experiment Stations.

periments with plants, especially cereals; experiments with hybrid orange trees; the culture of sugar beets, dates and tobacco; planting forest trees; the nutrition of farm animals and man; the gluten content of wheat; plants poisonous to stock; soil investigations; injurious insects, especially the codling moth and locust, and irrigation investigation.

THE OFFICE OF EXPERIMENT STATIONS.

During the past year the work of the Office of Experiment Stations has continued to increase by the addition of new enterprises and the further development of those previously undertaken. Agricultural experiment stations under the direct management of this Office have been established in Hawaii and Porto Rico, and in Alaska the station work has been extended to include experiments in the Yukon Valley. Both the nutrition and irrigation investigations have been conducted on a larger scale than in previous years. The amount of material prepared for publication during the year has exceeded that for any similar period since the establishment of the Office. Unusual opportunities have been afforded for the study of the more general problems relating to the organization and development of agricultural education and research, and there is good reason for believing that along the lines already laid the Office may be able in the future to extend its usefulness in promoting these important interests.

ALASKA EXPERIMENT STATIONS.

The experiment stations at Sitka and Kenai have been continued and a station has been established at Rampart in the Yukon Valley. The chief new feature of the investigations in Alaska during the past year has been the more thorough study of the agricultural possibilities of the interior, especially of the Yukon Valley and the Copper River region. For this purpose Professor Georgeson made journeys through the Yukon Valley in the summers of 1900 and 1901, and Mr. Isaac Jones, who has been the assistant at Rampart, traversed the Copper River region in the summer of 1901. Through these journeys definite information has been obtained regarding the attempts at agricultural operations already made in the regions traversed and the possibilities for the extension of such operations. It was shown that considerable quantities of hardy vegetables, such as potatoes, cabbage, cauliflower, turnips, lettuce and radishes are already being grown in the interior and there are large areas which may be used for this purpose and also for the production of grasses and forage plants. At the station at Rampart rye and barley were matured. At Sitka the experiments with cereals, forage crops and vegetables were continued and a considerable number of varieties were successfully grown. Good silage was also made of native grasses stored in a log silo.

At Kenai the experiments with cereals and vegetables were continued with considerable success. Seeds were distributed to 400 persons living in different parts of Alaska and a considerable number of reports were received of those grown during the season of 1900. It is evident that the efforts of the Government to aid in the development of agriculture in Alaska are greatly appreciated by residents of that Territory, and that they have already received substantial benefits from the work of the Alaska Experiment Stations. The assistant director of this Office, Dr. E. W. Allen, made a tour of inspection to the stations at Sitka and Kenai and reported favorably on their work.

HAWAII EXPERIMENT STATION.

The first appropriation for the establishment and maintenance of an agricultural

experiment station in Hawaii was for the fiscal year covered by this report. A preliminary investigation of the agricultural conditions existing in Hawaii with reference to the establishment of an experiment station was made by Dr. W. C. Stubbs, director of the Louisiana Agricultural Experiment Stations, acting under the direction of this Office. On the basis of his report a station was established with headquarters at Honolulu, and put in charge of Mr. Jared G. Smith. The station was located on the tract of land in Honolulu known as Kewalo-uka, which was assigned to this Department by the Government of the Territory of Hawaii. About fifty acres of this tract have been cleared and several small buildings have been erected. The investigations have thus far been confined to studies of a fungous disease which seriously affects taro, and studies of the diseases of poultry. Plans are being made for experiments in horticulture, including both fruits and vegetables, and coffee culture. Cooperative investigations in irrigation will also be undertaken.

PORTO RICO EXPERIMENT STATION.

The first appropriation ($5,000) for agricultural investigations in Porto Rico was made for the fiscal year ended June 30, 1901, and was used for making a preliminary investigation of the agricultural conditions existing in that island, with special reference to the establishment of an experiment station there. This investigation was in charge of Professor S. A. Knapp, formerly of the Iowa Agricultural College, and on the basis of his report Congress made a second appropriation ($12,000) for the current fiscal year, which authorized the Secretary of Agriculture to establish and maintain an agricultural experiment station in Porto Rico.

In the spring of 1901 the investigations in Porto Rico were put in charge of Mr. Frank D. Gardner, who has since made his headquarters at San Juan. The work thus far has been largely confined to an agricultural survey of the island with reference to the best locations for experimental investigations. Experiments in coffee culture and with other crops have, however, recently been undertaken on leased land at Rio Piedras. Studies of injurious insects and plant diseases have also been begun. Improved varieties of seeds and plants have been distributed.

STATISTICS OF THE STATIONS.

Agricultural experiment stations are now in operation under the act of Congress of March 2, 1887, in all the States and Territories, and, Alaska, Hawaii and Porto Rico. In Connecticut, New Jersey, New York, Hawaii, Missouri, Alabama and Louisiana separate stations are maintained wholly or in part by State funds. A number of substations are also maintained in different States. Excluding the substations, the total number of stations in the United States is 60. Of these, 54 receive appropriations provided for by act of Congress.

The total income of the stations during 1901 was $1,231,881.55, of which $720,000.00 was received from the National Government, the remainder, $511,881.55, coming from the following sources: State governments, $303,892.61; individuals and communities, $1,580.59; fees for analyses of fertilizers, $82,322.40; sales of farm products, $93,363.98; miscellaneous, $30,721.97. In addition to this, the Office of Experiment Stations had an appropriation of $125,000 for the past fiscal year, including $12,000 for the Alaska experiment stations, $10,000 for the Hawaiian investigations, $5,000 for the Porto Rican investigations, $15,000 for nutrition investigations, and $50,000 for irrigation investigations. The

value of additions to the equipment of the stations in 1901 is estimated as follows: Building, $133,420.77; libraries, $26,153.49; apparatus, $15,009.48; farm implements, $13,050.45; live stock, $17,120.29; miscellaneous, $25,025.10; total, $229,779.58.

The stations employ 719 persons in the work of administration and inquiry. The number of officers engaged in the different lines of work is as follows: Directors, 53; assistant and vice directors, 15; chemists, 146; agriculturists, 62; animal husbandmen, 14; horticulturists, 78; farm foremen, 21; dairymen, 31; botanists, 49; entomologists, 48; zoologists, 6; veterinarians, 29; meteorologists, 14; biologists, 7; physicists, 5; geologists, 5; mycologists and bacteriologists, 21; irrigation engineers, 8; in charge of substations, 12; secretaries and treasurers, 29; librarians, 11; clerks and stenographers, 40. There are also 72 persons classified under the head of 'miscellaneous,' including superintendents of gardens, grounds and buildings, apiarists, plant and animal pathologists, herdsmen, poultrymen, etc. Three hundred and nineteen station officers do more or less teaching in the colleges with which the stations are connected.

The activity and success of the stations in bringing the results of their work before the public continue unabated. During the year they published 445 annual reports and bulletins, which are many more than are required by the Hatch Act. These were supplied to over half a million addresses on the regular mailing lists. A larger number of stations than formerly supplemented their regular publications with more or less frequent issues of press bulletins, and most of the stations report a large and constantly increasing correspondence with farmers on a wide variety of topics.

FOREIGN EXPERIMENT STATIONS.

Instances of governmental activity for the advancement of agriculture in other countries are numerous, both in the Old World and the New.

The Russian department of agriculture and Imperial domains has inaugurated a system of commissioners of agriculture who will correspond in a general way to our commissioners of agriculture or to our secretaries of State boards of agriculture. Each commissioner's office will have connected with it a corps of agricultural specialists, who will work among the landowners and peasants. The Russian department of agriculture and Imperial domains is also displaying considerable activity in its soil and forestry investigations and in the establishment of stations for the investigation of special subjects, such as the growing of flax, cotton, olives, etc.

In Australia the Victoria department of agriculture is undergoing reorganization. The Victoria royal commission on technical education has brought to a close its study of Australian, European and American departments of agriculture, agricultural schools, and experiment stations, and published its final (sixth) report. The minister of agriculture is now seeking a director of agriculture, who will proceed to reorganize the department and put it on a better working basis.

In England the board of agriculture has made larger grants than formerly to agricultural colleges and societies for conducting agricultural investigations. The agricultural education committee is doing important work for agriculture and agricultural education by publishing circulars on various topics and nature study leaflets for teachers. During the year Mr. John S. Remington has established the Aynsome Experiment Station at Lancashire, a private institution.

The Austrian Government has recently

established several experiment stations, notably the station for plant culture at Brünn, the station for investigations in plant and animal production at Otterbach, and an agricultural physiological station, with divisions of chemistry, physiology and bacteriology, at Prague. In Hungary an experiment station for the analysis and study of wines was established last year at Fiune.

France has established at Nogent-sur-Marne a colonial garden to have administrative control over French colonial stations and botanic gardens in different parts of the world and to furnish these institutions with seeds and plants. During the year œnological stations have been established at Toulouse and Beaune and an agricultural station at Besançon.

In Germany five years of successful work at the Lauchstadt Experimental Farm, which is connected with the agricultural chemical experiment station at Halle, has given so much evidence of the value of experimental farms in connection with experiment stations that there is a movement in that country toward the extension of the so-called 'American system' of field experiments, conducted on a large scale and in a more practical way than has hitherto been customary in that country. Two new stations have been established during the year, a flax-culture station at Sorau and a viticultural experiment station at Weinsberg.

In the West Indies and South America also the claims of agricultural education and research have received much attention. The department of agriculture in the West Indies has established three new stations at Montserrat and one at Tortola, and has conducted several meetings of planters and investigators, at which great interest in the advancement of agriculture was displayed. The Bolivian Government has established an agricultural college at Cochabamba and an agricultural school for Indians at Umala. Brazil has recently established a botanical garden and experimental demonstration field at San Vicente, and the Argentine Republic has decided to establish four experiment stations on the same general plan as those in the United States.

A review of the progress of agricultural research during the year would not be complete without mention of the organization of a department of agriculture, with a small staff of experts, at Bangalore by the government of Mysore, India; the establishment of a dairy station at Gembloux, Belgium; a veterinary pathological institute and animal vaccine institute at Christiania, Norway; and an irrigation experiment station at Calgary, Canada.

A. C. TRUE.

OFFICE OF EXPERIMENT STATIONS,
U. S. DEPARTMENT OF AGRICULTURE.

SCIENTIFIC BOOKS.

Mechanical Drawing. By F. W. BARTLETT, Lieutenant Commander, U. S. Navy. New York, John Wiley & Sons. Pp. viii+190.

Although this book has been prepared primarily for students of the United States Naval Academy at Annapolis and indicates some of the distinctive features of the course in that institution, it must prove highly serviceable to the general student about to begin drafting. Without including either geometry or descriptive geometry—courses in which are given in another department of the Academy—the author restricts himself to the presentation and application of those practical methods which have commended themselves to the experts of the various departments of construction. The following, from the preface, will indicate the divisions cited: "As general methods differ slightly, the drawings referred to for the general instruction have been those of the Bureau of Steam Engineering of the Navy Department, and the methods of that Bureau have been followed. The special meth-

ods of the Bureau of Ordnance and of the Bureau of Construction are studied and used after the main course is completed."

One hundred and five of the hundred and ninety pages are devoted to a description of the drawing outfit, and to general directions as to its use. This portion alone is, fortunately, worth the cost of the book, for without the sectional models, which are referred to in the later pages and which form so valuable a feature of the Annapolis system, the outside student can hardly derive all the discipline intended from a course based on this work. Preliminary to the work from models two sheets of elementary plane figures are required, the first containing eighteen three-inch squares, filled with straight-line designs only. The second sheet affords about the same amount of practice with compass and irregular curves.

The book is well and practically illustrated, except in the matter of lettering, in which a standard far too low is set for Government work, not comparing at all favorably with that either of the leading bridge and locomotive companies, or of the draftsmen of the Coast and Geodetic Survey. As a whole, the book is a valuable addition to the literature of graphic science, and is likely to prove especially useful to teachers as a reference work.

Frederick N. Willson.

Princeton, N. J.

Preliminary Catalogue of the Crosby-Brown Collection of Musical Instruments of All Nations. I. New York, The Metropolitan Museum of Art, 1901. 8vo. Pp. 94, pl. 12.

This little work deserves a hearty welcome both for what it is and for what it forecasts in the future. All persons interested in tracing human development through the ages should know of this splendid collection of more than 2,500 instruments, nearly all presented by Mrs. John Crosby-Brown; the more one knows of it, the more he will feel the need of interpretation. This need is partly met in the sumptuous volume published in 1888 by Mrs. Brown and her son, Professor William Adams Brown, 'Musical Instruments and Their Homes.' Necessarily the work was mainly a compilation from writers of all degrees of competency, and since its date considerable new matter has become available, especially on the scientific side of the subject.

The present pamphlet has a more modest aim. It is a Catalogue of Gallery 27, which contains the Asiatic instruments. Great care has been taken to get the names properly spelled. The arrangement is first by countries, and then by cases; generally a very few lines of description and the dimensions of the instrument follow each title; there is no musical notation. The page is clear, the matter well displayed, and the proof-reading excellent. A full index of names, native and English, is provided. Twelve fine half-tone plates add much to the value of the book, and furnish beauty and instruction to those who cannot visit the Museum. Two of the plates show the Cristofori piano, the finer of the only two existing instruments made by the inventor of the piano. Of great interest to the student of scales is the half-page view of case 11, showing nearly twenty Japanese flutes with equally spaced holes, and several Pan's-pipes and xylophones that display a rectilinear or symmetrical construction, rather than a conformity to a law of reciprocals like ours. Those who believe there has been a universal desire for a diatonic scale will find it difficult to explain or explain away the facts that confront them in this case.

The future instalments of this catalogue will be awaited with interest; and when it is completed we trust the author's hope may be realized 'to issue an illustrated catalogue in which full justice shall be done to the many features of interest in the collection.' For 'full justice' means a work such as has never been attemped—such a work needs not merely a musician as Fètis or Engel or an instrument maker like Mahillon, but it needs the cooperation of the archeologist and ethnologist, the physicist, the philologist and the psychologist; and if the philosopher and the artist feel that they too have something to add to the understanding of musical instruments and of the men that made and used them, who shall deny the claim? The unprecedented opportunity before the Metropolitan Museum

and its liberal patron leads one to look for results far more full and satisfying than have yet been secured.

CHARLES K. WEAD.

SCIENTIFIC JOURNALS AND ARTICLES.

The Popular Science Monthly for June contains a series of papers 'On the Definition of some Modern Sciences,' presented originally before the Philosophical Society of Washington. The 'Introduction' is by W. H. Dall; Carroll D. Wright defines 'Statistics,' Roland P. Falkner 'Political Economy,' E. A. Pace 'Psychology' and Lester F. Ward 'Sociology.' Marshall O. Leighton discusses 'The Commercial Value of Human Life,' concluding that the pecuniary value of life is subject to the same economic laws as are applied to other commodities. 'Instinct' by Douglas A. Spaulding is a reprint of much value, as it contains the record of a series of important experiments on young birds which seem to prove that instinct is indeed inherited memory. Arthur C. Scott has an article on the 'Educational Value of Photomicrography,' describing some of the methods used and showing some of the results obtained. John Waddell considers 'Sugar and the Sugar Beet,' stating that the profits of beet raising average twenty dollars per acre. There is a biographical sketch of 'Peter Guthrie Tait' by C. K. Edmunds and J. McKeen Cattell presents some very decided ideas 'Concerning the American University.' There are also some good brief articles under 'The Progress of Science.'

IN *The American Naturalist* for May Henry F. Osborn discusses 'The Law of Adaptive Radiation,' the differentiation of habit in several directions from a primitive type. One of the conclusions reached is that function precedes structure. Charles T. Brues describes some 'New and Little Known Guests of the Texan Legionary Ants,' and in 'The Structure and Classification of the Trematastpidæ' William Patten presents the evidence for the arthropod affinities of the primitive 'fishes,' proposing for *Pterichthys* and allied forms the new class Peltacephala. Elliot W. Downing considers 'Variation in the Position of the Adductor Muscles of *Anadonta grandis* Say.' The number contains the Quarterly Record of Gifts, Appointments, Retirements and Deaths.

The Plant World for April contains 'Suggestions for the Preservation of Our Native Plants' by F. H. Knowlton, 'Among Florida Ferns' by A. H. Curtiss and shorter articles and reviews. In the Supplement Charles L. Pollard treats of the families of the Orders Primulales and Ebenales and begins that of the Gentianales.

Bird Lore for May–June opens with an article on 'The Increase of the Chestnut-sided Warbler' by A. Radclyffe Dugmore, illustrated with reproductions of some good photographs by the author. Francis H. Herrick writes of 'The Chebec's First Brood,' and Gerard A. Abbott describes 'A Grebe Colony.' The fourth paper of the series 'How to Name the Birds,' by Frank M. Chapman treats of the Tanagers, Swallows, Waxwings and Shrikes. The shorter articles, including notes, reviews and editorial comment, are all interesting.

The Museums Journal of Great Britain for May contains a description of the new Glasgow Art Gallery and Museum, which was an outcome of the successful international exhibition of 1888. The cost will be not far from $1,250,000. There is a series of notes on 'Some South African Museums' which shows that steady progress is being made in natural science, and the balance of the number is taken up with notes on British and foreign museums.

SOCIETIES AND ACADEMIES.

PHILOSOPHICAL SOCIETY OF WASHINGTON.

THE 553d regular meeting was held May 10, 1902, Vice-President Gore in the chair.

The first paper was by Dr. S. P. Langley, 'On the Laws of Nature,' is printed in the current issue of SCIENCE.

Mr. C. G. Abbot, of the Smithsonian Astrophysical Observatory, then read a paper on 'The Relation of the Sunspot Cycle to Meteorology.'* The author admitted as proved

* This paper will appear in the *Monthly Weather Review* for April.

that terrestrial magnetism and electricity, including the aurora, are directly affected when sunspots appear, and that while the evidence is less simple in the case of the meteorological elements, temperature, pressure, humidity and rainfall, there is a strong probability that they too are somewhat affected along with the sunspot frequency.

While admitting the possibility that magnetic and electrical disturbances are the causes of these meteorological changes attention was devoted only to the often made suggestion of a variability of solar radiation as an explanation of the supposed meteorological effects. Lockyer's views were discussed, and Halm's theory mentioned. It was pointed out that there is a ready way of determining whether changes of transmissibility in the solar atmosphere exist as required by Halm's theory. The great hindrance offered by the earth's atmosphere to direct measures by the actinometer of the variability of solar radiation was pointed out, and the variations noted in the results obtained at Montpellier since 1883 were attributed to the influence of water vapor. It was, however, pointed out that spectral actinometry by the aid of the spectro-bolometer might be more conclusive.

Professor C. Abbe presented the next paper. He said Professor A. Wolfer, who now succeeds Professor A. Wolf as Director of the Federal Observatory at Zurich, has lately revised the so-called Tables of Numbers expressing relative sunspot frequency, and has communicated the results of this revision to the Weather Bureau. By incorporating a number of newly discovered observations, especially a long series made at Kremsmunster, and by revising all computations so as to eliminate numerical errors, Professor Wolfer is now able to present a greatly improved table of numbers for each month from 1740 to date, and a list of the dates of each maximum and minimum since the days of Galileo. There is no evidence from this table of the thirty-five-year period, but a slight periodicity of fifty-five years is apparent. The intervals from minimum to maximum are always shorter than from maximum to minimum; that is to say, sunspots increase more rapidly than they decrease; moreover the intensity of a maximum is greater in proportion as the rate of formation of sunspots is greater. Professor Newcomb's studies on the sunspot period remain unaltered by the revision.

The communication will be published in full in the next number of the *Monthly Weather Review.*

The 554th regular meeting was held May 24, 1902, Vice-President Marvin presiding.

Mr. L. A. Bauer called attention to the remarkable magnetic disturbances now occurring, although this is near a sunspot minimum, and to simultaneous disturbances recorded at Cheltenham, Md., in Kansas and in Honolulu on April 18, the date of the Guatamalan earthquake; and to other disturbances closely coincident with the Martinique outburst. A fuller report of this matter will appear in Science.

The first regular paper was by Mr. G. K. Gilbert, 'On the Mechanism of Volcanoes.' The speaker said the matter to be presented was timely rather than novel. He accepted generally Major Dutton's views, but illustrated them by various instances from his own observations. The first problem is why the lava comes up: the primary force is gravitation, and the column of lava must exert less pressure in the depths than the neighboring solid rocks; accordingly the heavy, basic lavas, as basalt, in order to become light enough to rise must be highly heated, and are then very fluid; while the lighter, acid lavas rise in a very viscous condition, and flow slowly. The flow ceases because the supply of material lighter than the crust runs out. It is not yet clear how the liquid pierces the crust. Eruptions are of three kinds: dry, and then the lava flows quietly out of the crater or fissures; or wet, and then the occluded water expands into steam as the lava rises, thus forming a porous mass, as pumice, and liberating dense clouds; or explosive, as at Krakatoa, under conditions not well understood. Considerable discussion followed the paper.

Professor A. F. Zahm then read a paper on 'New Methods of Experimentation in Aerodynamics,' outlining a portion of the researches of Mr. Mattullath and himself at the Catholic

University of America, and describing the equipments and instruments of the laboratory of aerodynamics recently erected there by Mr. Mattullath. Both gentlemen have been working on similar problems for many years, and Dr. Zahm was Secretary of the Aeronautical Congress at Chicago in 1893. On the floor of the laboratory is a wooden tunnel fifty feet long by six feet square in cross section, having a five-foot suction fan at one end and a netting, or two, of close mesh at the other. A wind is thereby generated of practically uniform velocity and direction, the speed varying less than one per cent., the direction but a small fraction of a degree. In this current are held objects whose resistances, lift, drift, skin-friction, etc., are to be measured. Among the various anemometers and wind-balances designed for this purpose, is a pressure gauge graduated to millionths of an atmosphere, and which may be adjusted to read to less than one ten-millionth. It is connected by hose to one or more Pitot nozzles, and is used to measure the air velocity and pressure at all points of the stream, particularly in the neighborhood of the exposed body. The prime motive of these investigations is to furnish a basis for calculations in aeronautics, particularly in the theory of mechanical flight.

The Society then adjourned till October 11, 1902.

CHARLES K. WEAD,
Secretary.

DISCUSSION AND CORRESPONDENCE.

VOLCANIC DUST AND SAND FROM ST. VINCENT CAUGHT AT SEA AND THE BARBADOS.

SOME days ago the Weather Bureau forwarded to the Geological Survey for examination a package of volcanic dust which had been collected May 7 at sea on board the British steamship *Coya* by Capt. Thomas in latitude 11° 21′ N., longitude 57° 47′ W., or about 275 miles southeast of the island of St. Vincent, W. I. The dust began to fall about 10 p. m. May 7, and Capt. Thomas reports it thickest between midnight and 2 a. m. May 8th. At 1:30 p. m. local or sun time there was absolute darkness. The dust was supposed by Capt. Thomas to have resulted from the eruption on Martinique or St. Vincent. The upper currents of that region during May 5, 6 and 7 were reported west with easterly surface winds. The transfer of the dust is therefore probably due wholly to upper currents, but the matter cannot be advantageously considered until the facts of distribution over the whole field are available.

The material is yellowish-gray in color, and to the naked eye of remarkably uniform fineness, having been thoroughly assorted from the larger fragments in its long flight. The gritty feel suggests that its particles are sharp and angular, and so they are, in strong contrast with the smooth round grains of the wind-blown desert sands which roll upon the surface.

The particles are so small that a microscope must be used for their study and reveals a range in their size from a diameter of .3 mm. down to .001 mm. or less. The largest particles have a sp. gr. of 2.7, with others almost as large having a sp. gr. 3.3. Considering the great distance this dust traveled through the air before falling to the vessel, it is suprising that it sinks so rapidly in water. Stirred into distilled water and allowed to stand, in five minutes fifteen per cent. falls to the bottom, in ten minutes fifty-seven per cent., in ninety minutes ninety-seven, and yet this material traveled through the air 275 miles. It must have been hurled up very high and carried away by strong currents.

The dust is a mixture of crystal fragments and glass and is clearly of volcanic origin. The crystal fragments constitute about sixty per cent. of the whole mass, and embrace feldspar, pyroxene, magnetite and possibly a number of other minerals not readily identified under such conditions. Feldspar is by far the most abundant mineral, occurring frequently in cleavage plates some of which show well-defined albite twinning, while others probably parallel to a different cleavage do not. The extinction angles, which rarely rise to twenty degrees, indicate that the feldspar approximates labradorite or bytownite, although there may be some orthoclase present. Many of the feldspar grains are full of included glass and other matter at times arranged in bands

to mark zones of crystal growth. Quartz and orthoclase may be present in small quantities but they could not be positively determined.

Apparently two forms of pyroxene are present, a pale green non-pleochroic form whose prismatic fragments extinguish at a large angle and is probably augite, and a pleochroic yellowish form like hypersthene, but apparently having inclined extinction.

The glass particles vary greatly. Many are perfectly clear and transparent but rarely show the concave boundaries which are commonly characteristic of glossy volcanic dust. Occasional clear fragments are filled with microlites, minute crystals whose development was arrested by the eruption.

Opaque, white or yellowish-gray pumiceous fragments full of gas cavities are common and give color to the mass of which they constitute nearly twenty-five per cent. They appear to represent the molten material which floated the crystals and contained the explosive energy of eruption, blowing the mass to sand and dust with the relief of pressure. Although it is possible that the dust came from several sources, there is as yet no certain means of distinguishing the material from the different sources, nor in fact is there in the dust itself a definite suggestion of more than one source. In the process of crystallization the occluded gases are in large measure rejected and concentrated in the amorphous portion of the mass, so that when an outbreak occurs the glassy parts record the greatest expansion. The great distance traveled makes it probable that the proportion of amorphous material here is greater than in the original magma, for the crystal fragments being heavier would drop more readily than those of glass.

The destruction of St. Pierre has been attributed largely to gases shot out from the volcanic vent with burning sulphur, and it is probable that the gases ejected by la Souffrière on St. Vincent were of a similar nature. To get evidence concerning them it was proposed to crush the fragments of pumice in a vacuum and liberate the enclosed gases for chemical investigation, but the amount and character of the material at hand was entirely inadequate.

An inquiry as to the presence of soluble salts in the dust gave more definite data. None of the dust components thus far enumerated are soluble in water nor has it a decided taste, and yet when 10 grammes of the dust were treated with 400 cubic centimeters of water for 2 hours on water bath a neutral solution having the composition noted below with proportions indicating that the substances dissolved were $CaSo_4$ and NaCl and constituted about .5% of the dust. They were not discerned with certainty under the microscope but are supposed to appear as coatings deposited on some of the grains during the eruption. The large amount of superheated water vapor usually given off by volcanic eruptions is generally accompanied by much hydrochloric (HCl) and sulphurous acids (So_2), sulphurated hydrogen (H_2S) and other gases. The sulphurous acid upon reaching the air partially oxidizes to sulphuric acid, and with the hydrochloric acid would naturally attack the shattered lime-soda feldspar fragments forming a coating film of gypsum and common salt.

CHEMICAL ANALYSIS OF DUST FROM THE COYA I. AND OF HYPERSTHENE ANDESITE II. FROM CRATER LAKE, OREGON.

	I.	II.
Soluble in water.		
CaO	.20	
$(AlFe)_2O_3$	none	
Na_2O	.08	
SO_3	.29	
Cl	strong trace	
Insoluble in water.		
SiO_2	57.62	58.41
Al_2O_3	19.76	17.85
Fe_2O_3	3.43	2.67
FeO	3.90	3.29
MgO	1.82	3.61
CaO	6.25	6.81
Na_2O	3.79	3.77
K_2O	.71	1.23
H_2O-	.41	.34
H_2O+	.59	.86
TiO_2	.87	.69
CO_2	none	
P_2O_5	.17	.24

S	.11	
SO_3	none	
MnO	.08	trace
	100.08	99.77
		.05 (BaO)
		.05 (SrO)
		99.87

Native sulphur is abundant at Mt. Pelee as at many other volcanic vents and results from the reaction of the escaping gases SO_2 and H_2S. The last mentioned gas is readily inflammable and like SO_2 and HCl with which it is commonly associated issuing from volcanoes it is deadly and quickly proves fatal when inhaled in large proportions. To these heavy gases, in part inflammable, most likely commingled with others, is probably due the sudden destruction of life at St. Pierre.

The above chemical analysis I. by Mr. Steiger shows the presence of .11% sulphur in the insoluble portion of the dust. Tests with carbon disulphide indicate that the sulphur is not free but probably in the form of sulphides. No trace of boracic acid could be found, nor of ammonia or carbonic acid. Salts of ammonia and carbonates are formed only at low temperatures and would fail to leave a record among the solid compounds. Tests for arsenic and antimony were negative also.

By the kindness of Mr. W. C. Douglas, of the Geological Survey, I obtained a sample of the sand which fell at the Barbados, ninety miles from St. Vincent (one hundred and twenty from Martinique) on the afternoon of May 7. It was collected by Mrs. Mary D. Aughenbaugh, whose interesting observations are published in the *Evening Star,* Washington, D. C., May 23, p. 7: "Although the volcanic dust from St. Vincent was coming from the west there was a fairly strong east wind blowing all the time interspersed with hot waves of sulphurous air. The volcanic dust rained continuously here in Barbados from four o'clock P.M. Wednesday, May 7, until Thursday morning at five o'clock and accumulated to a depth of three fourths of an inch."

The particles of sand collected at the Barbados are of the same material as those noted in the dust collected by Capt. Thomas, although differing in proportion, and they evidently came from the same source, traveling between Barbados and the Coya in 6 hours, at the rate of nearly 31 miles an hour. Magnetite appears to be somewhat more abundant and much of it is enclosed in glass. The largest particles have a diameter of about .6 mm. with an average of .3 mm., and therefore a mass of over eight times that of the particles noted above borne to a distance three times as great. The sand from Barbados contains a much larger proportion of crystal fragments than the dust from the Coya, for the glassy matter is less than twenty per cent. The dust and sand from St. Vincent drifted mainly to the eastward, for the fall at Kingston, on the southwest side of St. Vincent, as reported by Mrs. Aughenbaugh was about as great as at Barbados, 90 miles away.

When compared with the dust and sand furnished by other volcanoes in recent years it bears the closest analogy with that of the Bogoslov eruption in Behring's Sea, October 23, 1883, and collected at Unalaska, sixty miles away. Mineralogically the sands are somewhat different and that at Unalaska is the coarsest, but they are alike in having a decided predominance of crystal fragments over those of volcanic glass. On the other hand, the dust from the great eruption of Krakatoa in the same year wafted many thousands of miles from its source was composed chiefly of glass particles, and crystal fragments formed a very small part of the mass. The explosion at Krakatoa was much greater than those of St. Vincent and Martinique. In both cases there was molten rock material erupted by the explosion, although at Krakatoa there was no flow of lava. In Japan, however, a few years ago the only material erupted was mud, giving evidence of the action of steam without real fusion. The character of the dust and sand examined is such as to indicate that if they were accompanied by lava streams upon the surface the streams would be similar to many flows in the Cascade Range of Oregon instead of the mud flows of Bandaisan in Japan. The similarity

is well illustrated by a chemical analysis given above (II.), made by H. N. Stokes of a hypersthene-augite andesite of Crater lake.

J. S. Diller,
George Steiger.

U. S. Geological Survey.

THE GRAY SQUIRREL AS A TWIG-PRUNER.

Last year my attention was called to some elm street trees in New Haven, which had been injured by having the twigs eaten off early in June. The twigs were cut off through the hard wood formed the previous season, just below the new growth. Under certain trees the ground was fairly covered with the detached twigs. No borers were found in the severed portions as is the case when infested by the oak pruner, *Elaphidion villosum* Fabr., which attacks several kinds of shade trees. Still, it was supposed that some insect caused the damage, as climbing cut-worms sometimes eat off the new growth—but usually through the soft tissue.

The present season, similar injury has been reported from Farmington and New Haven.

On May 23, while cycling through the streets of New Haven, I noticed a small elm tree under which the ground was covered with freshly severed twigs. The same tree was attacked last year. Four gray squirrels were seen in the top busily engaged in devouring the nearly ripe seeds. As the seeds of the American elm are near the extremity of last season's growth where the twigs are very slender, the squirrels were obliged to perform many noteworthy acrobatic feats in order to obtain the seeds. Some were hanging by the hind feet from slender branches to reach twigs beneath them, and all were munching away at the seeds as if half starved. In some cases they were not able to reach the clusters of seeds, and would bite off the twigs, which dropped to the ground where they could find their food later. Several twigs were dropped in this way in a period of about two minutes, while the writer was watching them. In some cases the squirrels cut off twigs from which they had already eaten the seeds. Trees bearing no seeds are not pruned in this manner, and none of the trees will probably be injured very seriously. This habit of squirrels may have been recorded by other observers, but I do not remember seeing it in print.

The best remedy seems to be to provide the squirrels with plenty of other food at this season of the year when their natural food supply has been nearly exhausted.

W. E. Britton.

Conn. Agr. Experiment Station.

W. E. HAMILTON.

In Chatham, Ontario, there died a short time ago William Edwin Hamilton, the elder son of Sir W. R. Hamilton, the great Irish mathematician. He gave his father some help in reading the proof sheets of the 'Elements of Quaternions,' and his name appears as editor on the title page of the first edition. As the book had been printed off in sheets under the care of his father, his work as editor of the posthumous volume did not amount to much. He had graduated B.A. at Trinity College, Dublin, and had been trained to the profession of civil engineer. The editing finished, he left for the West Indies, located in various parts of the New World, and finally settled down in Chatham, then the center of immigration to the peninsula of Ontario. He was employed on the newspaper of the town, and through drinking habits fell into very wretched circumstances. When I first saw him, underclothes were conspicuous by their absence, and his sleeping place was said to be the loft of a livery stable. By taking the gold cure he was able to master his alcoholic enemy; but no cure could recall or even make up for the years he had wasted. Every Saturday he might be seen distributing a leaflet of a newspaper called the *Market Guide,* which contained advertisements, a list of prices of farm produce, a few witticisms, and occasionally some doggerel verses which he called poetry. In his later years he lived poor but respectable. He loved to talk about the members of that brilliant society in which his father moved, and he had not a few friends who esteemed him, if not for his own, at least for his father's sake. He was about sixty years of age, and his death was very sudden.

Alexander Macfarlane.

CORRESPONDENCE OF RAFINESQUE AND CUTLER.

TO THE EDITOR OF SCIENCE: Apropos of the letter from Rafinesque to the Rev. M. Cutler, printed in SCIENCE of May 2 (pp. 713, 714), allow me to point out that another letter from Rafinesque to Cutler will be found in Cutler's 'Life, Journals and Correspondence,' 1888, II. 311–314. This letter is dated Palermo, January 28, 1807, and is signed 'C. S. Rafinesque-Schmaltz, Chancellor of the American Consulate, Palermo.' ALBERT MATTHEWS.

BOSTON, May 3, 1902.

MASS AND WEIGHT.

TO THE EDITOR OF SCIENCE: In view of the wide interest at the present time in the subject of measurement and in view of the probable change soon to be made in the national system, I beg to call attention to the great need for a radical change in the title used.

It has long been denoted a system of 'Weights and Measures.' This title, it seems to me, gives much undue importance to the idea of weight which is only a particular kind of a force. The weight idea is of little use except as a convenience in comparing masses at a single location. A standard of weight is of no real value, since weight is only the earth's attraction of a body, and depends upon the latitude, altitude, etc., of the body. Furthermore, since weight is only one of the many measurable quantities, what more is implied in the title 'Weights and Measures' than in the simple term *measurement*?

Commercially, the quantity of matter concerned, *i. e.*, the mass, is the real thing of importance; the balance being merely a convenient apparatus for comparing and so determining the relative values of masses.

I urge due consideration of this topic by all interested, feeling that a change in the wording of an old title is very desirable, and that the proper time to bring this about is the present. I suggest that the title 'Measurement' be employed in place of what seems to me the inappropriate term 'Weights and Measures.'

ARTHUR W. GOODSPEED.
RANDAL MORGAN LABORATORY OF PHYSICS,
UNIVERSITY OF PENNSYLVANIA.

SHORTER ARTICLES.

A SUPPOSED EARLY TERTIARY PENEPLAIN IN THE KLAMATH REGION, CALIFORNIA.

IN another paper, now in preparation, the writer will endeavor to show that remnants of an erosion base level equivalent to the late Tertiary peneplain of the Sierra Nevada region may be identified in the Trinity basin, between Trinity Center and Weaverville, in Trinity county, California, at an altitude of about 3,800 feet. While it yet remained a lowland plain, there rose abruptly above it on the west of the Trinity River the serpentine, granodiorite, gabbro and schist peaks of the Sierra Costa Mountains. Climbing to the summit of one of these peaks, we see what appear to be evidences of an older base level, a dissected peneplain.

With all its ruggedness and deep erosion, the Sierra Costa range is virtually a dissected plateau, about fifty miles in length in a direction north of east and twenty miles in average width. The principal peaks attain about the same altitude and none rise prominently above a general level. There is among them the regularity which we should expect from a very old peneplain which has been almost destroyed by erosion. There is nothing in the structure to explain this regularity, as the region is one mainly of huge *massifs* of serpentine, gabbro and granodiorite intruded into each other, with a belt of highly tilted schists on the southwest and limited areas of slate and greenstone toward the northeast.

From a position on the divide between Coffee Creek and its north fork, one of the high mountains between Trinity River and its east fork presents the appearance of an elevated plateau which one imagines to be about one square mile in area. From Grizzly Peak, a prominent mountain standing at the northeastern corner of the McCloud-Pitt projection of the Klamath region, one can look over all the mountains as far west as the Sierra Costa range, and this latter being so far distant, the valleys are not seen, but the peaks coalesce to form a crest-line whose evenness is startling to one used to the irregularity of Klamath topography.

These are the only evidences yielded by the Sierra Costa range similar to those usually depended on in the Mississippi basin to establish a dissected peneplain, and they may be deceptive, for it is not certain that the comparative uniformity in the height of the peaks may not be due to the intersection of slopes in accordance with the theory advanced by Penck. A symmetrical drainage system nearly everywhere trenched down to the late Neocene base level might be expected to reduce all the principal divides to about the same level.

But there is another and stronger evidence of peneplanation at the level of the high peaks. It is to be found in the behavior of the streams. In a general way the rivers and creeks of the Sierra Costa region ignore the structure. For instance, the old Coffee Creek rose in the Abrams mica schist (not very resistant relatively to other formations) flowed obliquely across on to the Salmon hornblende schist (quite resistant), made a sharp turn and then crossed at nearly a right angle belts of mica schist (not resistant), serpentine (moderately resistant), mica schist (not resistant), serpentine (moderately resistant), gabbro (very resistant), serpentine (less resistant), granodiorite (moderately resistant) and serpentine (less resistant). Why was not the stream deflected along the softer belts and around the *massifs* of gabbro and granodiorite if the structure in any way controlled the course?

All the higher peaks in this region are composed of granitic rocks, gabbro or hornblende schist, showing that these three are the most resistant to weathering. All the valleys narrow decidedly upon entering on the area of the gabbro and the hornblende schist showing that these formations are the most resistant to stream erosion. Yet the streams will cross these formations when they might take an easier course around them.

There is another way of looking at it: The granodiorite batholiths were the last to be intruded. They have the form of gigantic volcanic necks, being in most cases vertical columns of granitic rock rising up through the other formations. Whether or not any of the material ever reached the surface and formed rhyolite volcanoes, it is likely that the strata were more or less arched over these *massifs*. The bulging must have been effected so rapidly that any important streams flowing over their sites would be deflected. Without a subsequent rearrangement of the drainage system, the trunk streams should avoid these granite *massifs*, which in some important cases they do not. There can be little doubt that the drainage system of the Sierra Costa area is superimposed on the structure.

The independence of the Sierra Costa streams from the structure was already developed when the drainage was no lower relative to the rocks than the tops of the present peaks. It implies that a rearrangement had occurred previous to the beginning of trenching of the present valleys. Such a rearrangement must have been effected on a plain. When migration of streams is brought about during simple down-cutting or deepening of valleys it is controlled by the structure. A radical rearrangement independent of structure necessitates a plain, either of aggradation or of denudation.

This argument does not establish the connection between such a plain and the uniformity in height of the present peaks. We do not know whether the rearrangement occurred on an uplifted sea bottom (a plain of aggradation) or on a true baselevel of erosion. And if the latter, we do not know whether this baselevel was developed in the plane of the summits of the present peaks or higher in the strata. These are problems to be solved in the future. At present we can only say that the examination of the stream courses indicates that such a peneplain was developed, increasing the probability that the present summits of the Sierra Costa peaks do represent a dissected peneplain.

Very few geologists have climbed to the summit of the Sierra Costa Mountains. Dr. A. C. Lawson had a partial view of the supposed peneplain level from Battle Mountain, altitude about 7,675 feet above the sea. He recognized the pertinence of the evidence and was willing to accept the idea of the dissected

peneplain with a very strong element of doubt. Mr. J. S. Diller saw the summit level of the peaks from the top of Mt. Courtney, altitude about 8,800 feet, and he felt very strongly inclined to recognize the supposed eroded base level. As for myself, I have never before ventured to recognize a dissected peneplain on such slender evidence, but I think that in time it will come to be an established fact, although at present I shall refer to it with a question mark.

In the early stages of this investigation I entertained the idea that the dissected peneplain (?) of the Sierra Costa summits was of Cretaceous age, a portion of the same base leveled land surface on the borders of which after submergence the Horsetown and Chico sediments were deposited, but reflection has shown this to be improbable. The peneplain (?) has suffered little deformation over an area fifty miles long and twenty miles wide. It is not likely that such an extensive tract would remain intact while orographic disturbances of the greatest magnitude were occurring in its neighborhood. The inference is that it has been developed at a later date if it is really a feature of Klamath physiography, and must be credited to the early Tertiary times.

That such a peneplain was developed outside of the Sierra Costa area subsequent to the first post-Chico disturbance, over at least that portion of the Klamath region which had been covered by the Horsetown sediments, is evidenced by the behavior of the drainage system of that region. The northward drainage of the district between the Bully Choop range and the Trinity River was apparently inaugurated by the post-Chico disturbance, but since then there has been somewhat of a rearrangement of the system. A trunk stream ought to follow the line of basins marked by the four Cretaceous remnants south of the Trinity River, but, instead, all the main creeks cross this line and traverse the structurally higher ground on the north. Moreover, several of the most prominent streams as the Hay Fork, Salt Creek and the South Fork of Trinity River cross the line along the structural ridges which separate the basins, while one of the largest Cretaceous remnants constitutes the divide between two important creeks, Hay Fork and Salt Creek. The Indian Creek Cretaceous area is crossed by three parallel creeks, Indian, Reading and Brown's, separated by low divides where they are composed of the soft Cretaceous strata, yet these creeks traverse a high broad mica schist ridge in deep narrow gorges on their way to Trinity River. The drainage could not very well be more independent of the structure either of the metamorphic rocks or of the post-Chico deformation. It seems that the surface of this region was planed down and the streams then migrated and adopted the shortest course to the great trunk stream flowing west (or east) midway between the present Bully Choop range and the Sierra Costa range.

This rearrangement was not effected on the late Neocene surface (correlated with the Sierra Nevada peneplain), as the country of that time at some distance away from the main streams was too hilly. It seems rather to have been the result of the disturbance of an earlier peneplain—what more natural than to correlate it with the supposed dissected peneplain of the Sierra Costa summits!

In the extreme southwestern part of Oregon and in the adjoining section of California, Diller* has discriminated a dissected peneplain surface which truncates the tilted Miocene strata and hence is of late Tertiary age. It is best developed on the rocks of the Coast Range region, but also penetrates the Klamath region. Standing on one of the higher summits of the Sierra Costa range, as Mt. Thompson, altitude 9,345 feet, or Mt. Courtney, altitude about 8,800 feet, this peneplain is well displayed. It is marked by a general evenness of the surface of the mountain ridges which in the far distance merge into an apparent plain. It is as well preserved as one of the dissected peneplains of the Eastern States. The whole country to the westward of our position seems to have a general and even slope toward the west-southwest. There are a few monadnocks in sight, notably Preston Peak near the Oregon line.

* Coos Bay Folio of the Geologic Atlas of the United States.

Now the curious feature about this view is that the supposed dissected peneplain of the Sierra Costa mountains seems continuous with the more western peneplain, *which must be deceptive*. Taking into consideration a great arching of late Pliocene or early Pleistocene age which the uplifting of the Neocene channels in western Trinity and Siskiyou counties makes practically a certainty, we shall see that there cannot be a gradual and even slope in an older peneplain from the Sierra Costa Mountains to the sea. The peneplain (?) of the Sierra Costa summits should rise up several thousands of feet west of Mt. Thompson before beginning its slope toward the ocean. Instead, the general surface drops away rapidly at the western edge of the Sierra Costa Mountains and no peneplain is represented for some miles westward. This fact is not at first appreciated, and hence the impression that the peneplain west of this eroded area is the same as that supposed to pass through the Sierra Costa summits.

My explanation is that the Sierra Costa peneplain (?) has been destroyed throughout the country west of Mt. Thompson, but that a later and lower peneplain was developed in that direction. This will be tentatively correlated with the late Pliocene base level of the old Trinity valley, because it is below this western peneplain that the deep Sierran valleys are trenched. The arching of the surface, to which is apparently due the deep gorges of the lower Trinity and Klamath rivers brought up this later peneplain to such a level as to make it appear a projection of the Sierra Costa peneplain (?).

The latter, if it ever existed, is regarded as virtually destroyed throughout the Klamath region except over the Sierra Costa Mountains and a few outlying ridges and peaks. In a general way, the Marble Mountain range and a part of the Siskiyou range seem to answer the requirements of such remnants. It is possible also that the Yallo Ballo Mountains, Bully Choop Peak, the Towerhouse Bally and some of the higher points of the Rogue River range may reach nearly to the old peneplain (?) level; but all the remainder of the Klamath area was reduced much below that level by the close of the Tertiary era.

There has been too much generalizing in the past on the subject of Klamath physiography, and this paper, by intimating some of the complexities of the problem, may be considered a protest against it.

Oscar H. Hershey.

Berkeley, Cal.,
Nov. 14, 1901.

THE RATE OF INTEREST ON GOVERNMENT SECURITIES.

McCoy's Tables, issued by the Treasury Department at the commencement of each month, exhibiting the market prices and investment values of the securities of the United States, attract little attention from the public or the press and yet they contain the most perfect measure of the business conditions, the healthfulness of the industries and the public credit that can be found. The issue of June 2, giving the figures for the month of May, has just come to hand. There are five issues of securities, the 'consols' of 1930, the Loan of 1908–18, the Funded Loan of 1925 and the Loan of 1904. These bear, respectively, 2, 3, 4, 4 and 5 per cent. interest and mature at the latest of the dates given above for each. Interest is payable quarterly.

The Two-per-cents of 1930 sold at an average of 109.5375, netting to the purchaser an average of 1.587 per cent. The Threes of 1908–18 sold at 108.4775, bringing in 1.584 per cent. The Fours of 1907 brought 110.3225 earned, net, 1.784. The Fours of 1925 give the figures 137.3920 and 1.957. The Fives of 1904 similarly give 105.8237 and 1.547.

The Fives of 1904 have the highest price of any securities, governmental or private, now in existence or which ever were known in history. The credit of the United States, at this moment, stands higher than that of any other nation, contemporary or of earlier times. The Two-per-cent Consols measure that credit perhaps more accurately than any other of these securities and are sold at a higher figure than ever were any such securities in the history of finance. During this

period the rates for time-loans in the New York market were usually from four to four and a half per cent. for the best paper, Government securities thus indicating practically double the value of private credit. British consols sold at 96⅝, French *rentes* at 101.225, German 3½ per cent at 102, Spanish Fours 78¼ in London. Foreign Municipal Fours sell at par. During the same period the best railroad Four-per-cents sold in New York at about 105 and the Fives at 125.

RAILWAY ARRANGEMENTS FOR THE PITTSBURGH MEETING OF THE AMERICAN ASSOCIATION.

THE Local Committee for the Pittsburgh meeting of the American Association for the Advancement of Science and Affiliated Societies hereby announces the final arrangements made with the various Passenger Associations regarding rates and conditions connected with the purchase of tickets and extension of time limits.

The *Central, Trunk Line, Western,* and *New England Passenger Associations* have granted a rate of one fare and one third for the round trip, on the certificate plan.

Tickets at full fare for the going journey may be obtained from points within the territories of the *New England, Trunk Line,* and *Central Passenger Associations,* from June 19 to June 30 and from points within the territory of the *Western Passenger Association,* from June 19 to June 25 inclusive.

Delegates to the meeting should bear in mind the necessity of obtaining a *certificate* from the office where the ticket is bought. Do not make the mistake of asking for a *receipt.*

A special form of certificate has been issued for this Convention and anybody neglecting to obtain it, properly made out and signed by the selling agent, will be compelled to pay full fare on the return trip.

Certificates are not kept at all stations. It is essential that special inquiry be made regarding this matter at least thirty minutes before departure of train.

If the agent at the station where the ticket is bought is not supplied with certificates, he will inform delegates at what station they can be bought. Buy a local ticket to the station designated and there take up a certificate and through ticket.

Upon arrival at Pittsburgh delegates should hand their certificates to the *Permanent Secretary* who will in turn hand them to the *Local Secretary* and special agent for endorsement. Even if certificates are properly made out and attested by the ticket agent at the selling office, they will not be honored for reduced fare on the return trip unless they are endorsed by the Local Secretary and validated by the special agent of the Railway Associations, and after being thus endorsed and validated they will not be honored for reduced rate on return trip unless they are deposited with the agents of terminal lines in Pittsburgh on or before July 9.

It has been arranged that a special agent of the Railway Associations will be in attendance to visé certificates on June 28, 29, 30, July 1, 2, and 3. A charge of twenty-five (25) cents for validating each ticket is made by the railways to defray cost of presence of special agent.

To prevent disappointment, it must be understood that the reduction on return journey is not guaranteed, but is contingent on an attendance of not less than 100 persons holding certificates obtained from the ticket agent at starting points showing payment of full first-class fare of not less than seventy-five (75) cents on going journey; provided, however, that if the tickets presented fall short of the required minimum and it shall appear that round trip tickets are held in lieu of certificates, they shall be reckoned in arriving at the minimum. This ruling regarding the minimum of 100 applies to the Western, Central, Trunk Line, and New England Passenger Associations. In each instance the return journey must be made by the same route traveled on the going journey, and it must be continuous.

If the necessary minimum is in attendance and certificates are properly made out and attested by the selling agent, acknowledged by the Local Secretary, validated by the special agent, and deposited with agents of ter-

minal lines in Pittsburgh on or before July 9, holders of same will be entitled up to August 31 to a continuous passage ticket by the route over which going journey was made, at one third the first-class limited fare.

Extraordinary concessions have been made for this Convention by the above-named Passenger Associations in allowing the purchase of tickets for the going journey eight days prior to any of the scheduled meetings and extending this privilege up to and including June 30. For obvious reasons this concession has been slightly modified as above noted by the Western Passenger Association. The extension of time limit on the return tickets to August 31 is decidedly out of the ordinary. An exception of the usual rule requiring the return journey to be made at least three days after adjournment, was granted at the earnest request of the Chairman of the Local Committee, Dr. W. J. Holland, expressed through the Chairman of the Transportation Committee, Col. Samuel Moody, Assistant General Passenger Agent of the Penna. Lines West of Pittsburgh.

The *Southeastern Passenger Association* will sell tickets on the regular certificate plan conditions, namely: Certificates to be issued in connection with going ticket three days before (Sunday not included) and two days after the first day of meeting, and to be honored for return tickets up to and including third day of adjournment. This means that tickets will be sold on June 25, 26, and 27 and honored for the return journey from June 28 to July 6 inclusive. Instructions regarding purchase of tickets, obtaining certificates, and having certificates acknowledged and validated at Pittsburgh are the same as those given above for the other Passenger Associations with the exception, however, that no certificate will be honored for the return ticket unless presented during the time that the meeting is in session or within three days (Sunday not included) after adjournment.

The *Transcontinental Passenger Association* has not granted a special rate for this Convention, but suggests that delegates using their lines avail themselves of the privileges afforded by purchasing a nine-months' tourist ticket. This means transportation from extreme Western points to territory granting the rates above given, at two cents per mile, and is about equivalent to a rate of one fare and one third for the round trip.

The *Southwestern Passenger Association* has refused to grant any reduction of fare for this Convention.

George A. Wardlaw,
Local Secretary.

SCIENTIFIC NOTES AND NEWS.

The Senate of Dublin University has voted to confer the degree of Doctor of Science on Professor J. Willard Gibbs, of Yale University.

Dr. Carlos Finlay, of Havana, eminent for his work on yellow fever, has been given the degree of Doctor of Science by Jefferson Medical College, from which he graduated in 1855.

It appears from reports in the daily papers that American men of science—Dr. R. T. Hill, U. S. Geological Survey; Dr. Angelo Heilprin, Philadelphia Academy of Natural Sciences; Dr. T. A. Jagger, Harvard University, and Dr. E. O. Hovey, the American Museum of Natural History—have made careful observations of the geological conditions following the volcanic eruptions in the lesser Antilles.

President David Starr Jordan will leave on June 12 on the steamer *Sierra* for Samoa, where he will spend the summer in the investigation of the fishes and other marine animals of the Samoan islands. The work will be done for the United States Fish Commission, and Professor Vernon L. Kellogg, of Stanford University, will accompany Dr. Jordan.

Mr. J. S. Budgett, F.Z.S., Balfour student of the University of Cambridge, left England on May 22 for Uganda, via Mombasa, on a mission from the Zoological Society of London. He will proceed to the southeastern corner of the Protectorate, and take up a station on the Semliki River, where he will collect mammals and birds, study the fishes, and endeavor to investigate the habits of the okapi in the forest of Mboga. Mr. Budgett, who has already paid two visits to the Gambia, is a

practiced collector of fishes and an experienced African traveller.

DR. LEOPOLD BATRES, conservator of national monuments, of Mexico, has returned from explorations of the ruins of Zapotecan cities in the State of Oaxaca.

DR. D. C. GILMAN, president of the Carnegie Institution, is at present in Germany, where he is holding consultations with the leading German men of science in regard to the plans of the institution.

THE bill to permit the retirement of Surgeon-General Sternberg with the rank of major-general was defeated by a vote of 68 to 103 in the House on June 2.

DR. WM. J. GIES, adjunct professor of physiological chemistry in Columbia University, has been appointed consulting chemist to the New York Botanical Garden.

PROFESSOR R. A. ZIMMERMANN has been appointed botanist to the Biological Station at Tanga in the German possessions in East Africa.

PROFESSOR LEWIS SWIFT, who is said to have discovered fifteen comets, has recently celebrated his eighty-first birthday.

DR. KARL NEUMANN, professor of mathematics at Leipzig, has celebrated his seventieth birthday.

DR. JOHN K. REES, professor of astronomy at Columbia University, will give the commencement address before the Worcester Polytechnic Institute, his subject being 'Recent Progress in Astronomy.'

AT the meeting of the Royal Geographical Society, on May 26, the following awards were made:—The Murchison grant for 1902 to J. Stanley Gardiner, for his researches in Funafuti Island, in the Pacific, and the Maldive Islands, in the Indian Ocean. The Gill memorial for 1902 to G. G. Chisholm, for the services rendered during 25 years to geographical education by text-books of various kinds, atlases and lectures, all of a high standard of value as well as for his geographical investigations, among other subjects into cataracts and waterfalls, and on the sites of towns. The Back grant for 1902 to Lieutenant Amdrup, for his two voyages of exploration to the east coast of Greenland, during which he surveyed and mapped in detail much of the coast hitherto unknown or imperfectly mapped. The Cuthbert Peek grant for 1902 to J. P. Thomson, who was founder of the Queensland branch of the Australian Geographical Society and by his writings and in other ways has done much to promote the interests of geography in Queensland.

PROFESSOR EMMETT S. GOFF, professor of horticulture at the University of Wisconsin, died on June 6 in Madison, after a short illness.

THE Rev. Dr. John Henry Barrows, president of Oberlin College, died on June 3, aged fifty-five years. Dr. Barrows was well known as an educator and author, and for the part he took in organizing the Parliament of Religions at the World's Columbian Exposition.

MR. W. H. AUSTIN, senior wrangler and Smith's prizeman at Cambridge and lecturer on mathematics at the University of Birmingham, died on May 20, at the age of twenty-seven years.

THE American Medical Association is this week holding its fifty-third annual meeting at Saratoga with about two thousand physicians in attendance.

THE American Institute of Electrical Engineers will hold its nineteenth annual meeting at Barrington, Mass., beginning on June 18.

THE American Electrochemical Society will hold its second general meeting at Niagara Falls, N. Y., beginning Monday, September 15.

THE position of computer in the Coast and Geodetic Survey at a salary of $1,000 will be filled by civil service examination on July 8 and 9. The position is open both to men and women.

THE New York City Board of Estimate has authorized the issue of $600,000 bonds, for the City College; $200,000 for the Museum of Natural History; $250,000 for new library sites, and $125,000 to begin the work of estab-

lishing public baths in Manhattan and Brooklyn.

Carl Faber, of Munich, a son of the late Johann Faber, the pencil manufacturer, has given 1,000,000 Marks for the Germanic Museum at Nuremberg and to the Bavarian National Museum at Munich.

Members of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the American Institute of Mining Engineers, and the American Institute of Electrical Engineers have united to found a gold medal in honor of the eightieth birthday of John Fritz, the eminent metallurgist. It is hoped that subscriptions of $10 amounting to five or six thousand dollars will be made.

There has been erected in Schenley Park, Pittsburgh, as gift of Mr. Phipps, a Hall of Botany. It adjoins the conservatory, being a substantial brick building equipped with laboratory facilities. The hall is for the study of botany by the school children of the city.

The Antwerp Geographical Society has opened an exhibition in the Zoological Park illustrating the recent progress of geological discovery.

In July next another German expedition will start from the West African coast for Lake Chad. This time it will have more of a scientific nature and will really be undertaken to study the products of the German territory up to the lake with a view of ascertaining the commercial value.

The British Board of Agriculture is informed by the High Commissioner for Canada that the Canadian Government has sent Mr. A. G. Hopkins, veterinary quarantine officer for Canada, to England to apply the tuberculin test to all cattle over six months old intended for export for breeding purposes from the United Kingdom to Canada.

The California Chapter of the Society of the Sigma Xi was organized this spring at the University of California. The total membership of the Chapter now number forty-nine, which includes the following students, recently elected from the scientific colleges: *Graduates:* E. Baruch, F. C. Calkins, R. T. Crawford, R. H. Curtiss, H. M. Hall, A. S. King, H. K. Palmer, and W. J. Sinclair. *Seniors:* A. Adler, J. S. Colbath, B. A. Etcheverry, C. O. Esterly, E. Everett, D. Finley, J. Newfield, G. C. Noble, C. P. Richmond and C. A. G. Weymouth.

Mr. W. Bruce, who is to lead the Scottish Antarctic expedition, has received a letter from Professor von Drygalski, leader of the German South Polar expedition, announcing the arrival of the *Gauss* at Kerguelen at the beginning of January. The expedition will therefore have made the ice at about the same time as the Swedish and British ships. Dr. von Drygalski has penetrated the Antarctic region at the point of the still hypothetical termination island in order to discover the western side of Victoria land and clear up its possible connection with the Kemp and Enderby lands. By taking this route he believes he may be ultimately able to sweep westwards by a high southern latitude into the South Atlantic and emerge by way of South Georgia.

The Berlin correspondent of the London *Times* writes under date May 25:—"Experiments were made last year at the General Telegraph Office in Berlin with the octoplex system of typographic telegraphy invented by the late Professor Henry A. Rowland, of Baltimore. The necessary apparatus for communication with Hamburg and Frankfort is being installed and will shortly come into use. It is claimed for the octoplex system that it enables a total of 20 officials at the despatching and receiving stations to send in one hour 18,000 words on a single wire. By the Hughes system at present in use between Berlin and the towns just mentioned it is not possible to send more than 2,200 words in the hour. The despatching instrument of the octoplex system resembles the Remington typewriter, and any given letter can be telegraphed by the depression of the proper key, whereas in other systems the depression of more than one key is usually necessary to form the current required to telegraph a letter. The labor of the despatching clerk is thus lightened, while at the same time the receiving in-

strument, by printing the message on a sheet of paper instead of on a tape, enables the attendant official to detach and forward the telegram as soon as it is concluded. If the system proves to be successful in practice, the result will be to relieve the congestion from which the wires now suffer, and thus to enable many places, which, owing to their distance from one another, have hitherto had to be content with an indirect service, to enjoy direct communication."

CONSUL G. W. ROOSEVELT, of Brussels, writes to the Department of State: In 1898, an international competition for a paste for matches not containing white sulphur was announced, and a prize of 50,000 francs was offered by the Belgian Government to the inventor. The commission appointed to judge results has now declared that, after four years of careful experiment and analysis, it has been found that none of the products so far submitted fill the required conditions, being defective in inflammability, igniting on all surfaces, or, in igniting, ejecting inflammable matter containing some poisonous substance. The sum already expended in the matter amounts to 8,178 francs. This covers cost of printing, correspondence with foreign countries, purchase of material, analysis and experiments.

WE learn from the London *Times* that an international agreement for the protection of birds useful to agriculture was concluded in Paris on March 19. The parties to the agreement are Belgium, France, Greece, Lichtenstein, Luxemburg, Monaco, Austria-Hungary, Portugal, Sweden, Switzerland and Spain. The agreement contains 16 clauses, of which the first states that birds useful to agriculture, especially insect eaters and birds enumerated in the lists attached to the agreement, are to enjoy an unconditional protection and that the destruction of these birds, their nests, eggs and broods is to be forbidden. Certain nocturnal birds of prey, as well as woodpeckers, bee-eaters, swallows, and several birds of the sparrow species, appear as useful birds, while ravens, magpies, jays and others are branded as mischievous. Some exceptions protect sporting and other rights. Italy, a country in which the capture of northward-bound birds is a regular trade, does not appear amongst the signatories. According to statistics recently given in the Reichstag no less than seven hundredweight of migratory birds were put on the Verona market at one time. The agreement will shortly be submitted to the Reichstag.

DURING the coming summer the United States Geological Survey will continue the study of the lead and zinc fields in northern Arkansas; this work will be under the charge of George I. Adams, assistant geologist, who will be assisted by Professor A. H. Purdee, of the Aransas State University, and by Ernest F. Burchard. In this investigation an attempt will be made to describe all the camps of that important section and in particular will include a careful survey of the territory covered by the Government topographic map sheet known as the Yellville quadrangle, which includes most of Marion and parts of Boone, Newton and Searcy counties. This work will be a continuation in detail of the study of the Ozark lead and zinc region, which includes northern Arkansas upon which a preliminary report by Baine and Adams was issued in the last annual. The results of the work will be a report on the lead and zinc field of northern Arkansas, together with a geological folio, which will follow other similar folios, issued by the Geological Survey, in giving an accurate geological description of the region, illustrated by maps showing the topography and also the surface, economic and structural geologic features. At the close of his work in northern Arkansas, Mr. Adams will be engaged in a reconnaissance in northern Texas for the purpose of determining the stratigraphic relations existing there between the Carboniferous and the so-called Red-beds; it is expected that this work will throw light upon the disputed problem of the extent of the Permian formation in that region. Mr. Adams has recently published a report on the oil and gas fields of the western interior and northern Texas Coal Measures, and the Upper Cretaceous and Tertiary of the western Gulf Coast, which appeared as Bulletin 184 of the United States

Geological Survey. A documentary edition of this bulletin for free distribution, upon application to the director, is now available.

UNIVERSITY AND EDUCATIONAL NEWS.

BRYN MAWR COLLEGE has secured gifts amounting to $256,000, thus making available the conditional gift of $250,000 offered by Mr. John D. Rockefeller.

FRIENDS of Columbia University have purchased from the New York Hospital for $1,900,000 the two blocks of land facing the University. It is hoped that this land may be ultimately acquired for the use of the University.

THE valuable natural history collections, of the late Dr. C. Kramer, professor of botany at the Polytechnic Institute at Zurich, has been presented by his heirs to the institute.

EFFORTS are being made to establish a university at Frankfort on the Maine. The city possesses in its Schenkenberg Institute a school of natural science and medicine, and there is also in the city a commercial school. The trustees of the Karl Juegel's bequest, amounting to about $500,000, have decided to use the fund for a school of law, history and philosophy. The proposal now being considered is to unite these various institutions in a new university.

THE University at Jena has established introductory courses in Greek and Latin for students from the Realgymnasia and Oberrealschulen who decide after coming to the University that they wish to study law.

THE Omaha Medical College has recently become the medical department of the University of Nebraska. The first two years of the course will be given at both Omaha and Lincoln.

AT the Jefferson Medical College, Philadelphia, Dr. Julius L. Salinger and Dr. Thomas G. Ashton have been elected professors of clinical medicine.

THE School of Practical Agriculture, in which a number of New York citizens are interested and of which Professor George T. Powell is director, has purchased 415 acres of land for a site.

AT Columbia University Professor Friedrich Hirth, of Munich, has been appointed head of the recently established Dean Lung Department of Chinese, and Dr. Felix Adler to a newly created professorship of social and political ethics. At the College of Physicians and Surgeons, the medical department of the University, Dr. Emmett Holt has been appointed clinical professor of the diseases of children, succeeding Dr. Abram Jacobi, who had held this position for more than thirty years and now becomes professor emeritus. Dr. Russell B. Opitz has been appointed demonstrator in physiology and Dr. R. E. Buffington, assistant in normal histology. Mr. J. H. Bair has been made assistant in the department of anthropology, and Miss Jean A. Brodhurst, assistant in botany at Barnard College.

PROFESSOR LYMAN S. MOREHOUSE, of Washington University, St. Louis, has accepted a chair of electrical engineering at the University of Michigan.

MR. ARTHUR E. WADE, '02, of Cornell College, Iowa, has been appointed demonstrator in chemistry at the Sioux City Medical College.

AMONG the announcements made by President Goucher at the commencement of the Woman's College of Baltimore on June 3, were the following: Dr. Florence Peeble, instructor of biology, has been advanced to assistant professor. Miss Marie Eleanor Nast, Cincinnati, Ohio, who receives the fellowship given each year to a member of the graduating class, will study biology and physiology at the University of Chicago. Miss Nast last year received from the Woman's College a scholarship entitling her to study at the Marine Laboratory at Wood's Holl. Two Wood's Holl scholarships granted this year are awarded to Miss Mary Taylor Abercrombie, '03, Baltimore, Md., and to Miss Miriam Alice Belt, '03, Beltsville, Pa. A scholarship entitling the holder to work at Cold Spring Harbor is awarded to Miss Mary E. G. Lentz, Baltimore, Md.